A STRUCTURAL STUDY OF A MIXED-VALENCE COMPLEX OF COBALT AND DIACETYL-OXIME-ANIL

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A STRUCTURAL STUDY OF A MIXED-VALENCE COMPLEX OF COBALT AND DIACETYL-OXIME-ANIL

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SUMMARY

Bis[tris(2-phenylimino-3-oximo-butanato)cobalt(III)] cobalt(II) perchlorate was prepared and the structure determined via single crystal x-ray methods. The structure contains trinuclear cations and discrete perchlorate anions. The trinuclear cation consists of a central cobalt(II) ion located between two octahedrally coordinated tris(2-phenylimino-3-oximo-butanato)cobalt(III) groups. Each ligand is coordinated to cobalt(III) through the imine and oxime nitrogens with the six oxime oxygens of two such complexes octahedrally coordinating the central cobalt(II).

The temperature-independent magnetic moment from a previously published study is consistent with the presence of a high-spin, octahedrally coordinated cobalt(II) and two diamagnetic cobalt(III) ions.

CHAPTER I

INTRODUCTION

Although it is possible, on the basis of current understanding of the electronic states associated with d^n configurations, to predict the magnetic moment of most transition metal complexes, there are a number of complexes reported with anomalous magnetic moments. In recent years these compounds have received considerable attention and, on the basis of structure determinations and other studies, it has been possible to explain the "anomalous" behavior of many of these compounds. From these studies, there appear to be four distinct categories of complexes with "anomalous" moments. First, there are polynuclear complexes which contain metal-metal bonds. Examples include $Re_2Cl_8^{2-}$, $Mn_2(CO)_{10}$, $Co_2(CN)_{10}^{6-}$, $Cu_2(O_2CCH_3)_4(H_2O)_2$, and $Cr_2(O_2CCH_3)_4(H_2O)_2$.[1] Complexes of this type exhibit subnormal magnetic moments compared with values expected for isolated metal ions due to pairing of spins in metal-metal interactions. In the case of strong interactions, such complexes are diamagnetic. Second, there are polynuclear complexes which exhibit exchange interactions through bridging groups. Spin coupling can occur through a variety of bridging groups, but the most extensively studied complexes are oxygen-bridged

copper(II) complexes.[2] Third, there are cases in which the complex is incorrectly formulated as a single valence state. On the basis of mixed-valence, their "anomalous" magnetic properties can be explained. Complexes of the formula $[M(II)(H_2O)_6][M(III)(SALGLY)_2]\cdot 2H_2O$ (where M = Co, Mn, Fe)[3-6] are representative examples (All abbreviations of ligands are listed in Tables 1 and 2). Finally, there are complexes which exhibit spin-state equilibria. In these complexes, high-spin and low-spin states have similar energies resulting in a thermal population of different spin states. Complexes of iron(III) containing dithiocarbamate ligands are the earliest examples and have been extensively studied in recent years.[7,8]

Uhlig and Dinjus reported compounds of the formula $[Co(Dma)(Dma-H)B]ClO_4$ (where B = C_5H_5N or $C_6H_5NH_2$).[9] The magnetic moments reported for these compounds, ranging from 3.18 to 3.62 B.M., are considerably below the range expected for cobalt(II).

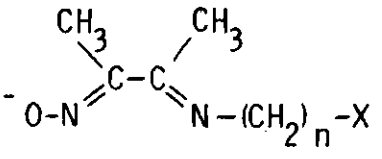
As an explanation for the unusual magnetic moments, Uhlig and Dinjus proposed that these complexes are dimeric in the solid state with a cobalt-cobalt bond. Cobalt(II) dimers with cobalt-cobalt bonds have been reported. $Co_2(CN)_{10}^{6-}$ and $Co_2(CNCH_3)_{10}^{4+}$ are examples.[1]

The possibility of a mixed-valence compound of cobalt (II) and cobalt(III) was not considered, presumably because the preparations were carried out under an inert atmosphere.

Table 1. Abbreviations Used for Ligands

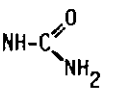
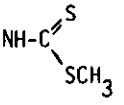
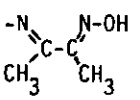
Deta	the dianion of 2,2'-dihydroxydiethylamine
Eta	the anion of 2-aminoethanol
Dma	the anion of diacetylmonoxime anil
SALGY	the dianion of the imine of salicylaldehyde and glycine

Table 2. Abbreviations Used for Ligands[2]



Ln X

n will always be an integer

n	X	Symbol	n	X	Symbol
n=2,3	OH	Lnaℓ			
n-2,3	NH_2	Lnam	0		LOsc
2	α-pyridine	L2pyr			
2	$(C_2H_5)_2N$	L2dea	0		LOdts
1	CH_3	Let			
			3		L3LH

However, similar magnetic moments have been reported for compounds formulated as cobalt(II) when both cobalt(II) and cobalt(III) were present.

Structural and magnetic studies of mixed-valence cobalt compounds show that they fall into two categories. First, there are those which show temperature-dependent magnetic moments due to coupling between paramagnetic centers. And second, there are those which show temperature-independent magnetic moments due to the presence of a single paramagnetic center.

An example falling into the first category was reported by J. A. Bertrand and T. C. Hightower.[10] Di-μ-acetato-tetrakis-[μ_3-methoxo-2,4-pentanedionatocobalt(II,III)] (abbreviated as Co-cubane, Figure 1) shows magnetic coupling (4.98 B.M. at room temperature and 4.62 B.M. at liquid N_2 temperature). Also, $[Co(II)Co(III)(Deta)_2(Deta\ H_2)]_2(ClO_4)_2$ (abbreviated as CoDeta) was reported by E. Fujita[11] with a structure similar to that of titanium alkoxides. It shows a temperature-dependent magnetic moment (5.19 B.M. at room temperature and 5.07 B.M. at 93°K) and thus, coupling between cobalt(II) ions. Both compounds contain a Co_2O_2 four membered ring (planar for CoDeta and bent for Co-cubane) permitting coupling between cobalt(II) ions, and additional bridging by the acetate ion in Co-cubane provides another possible coupling pathway.

An example falling into the second category, bis[tris

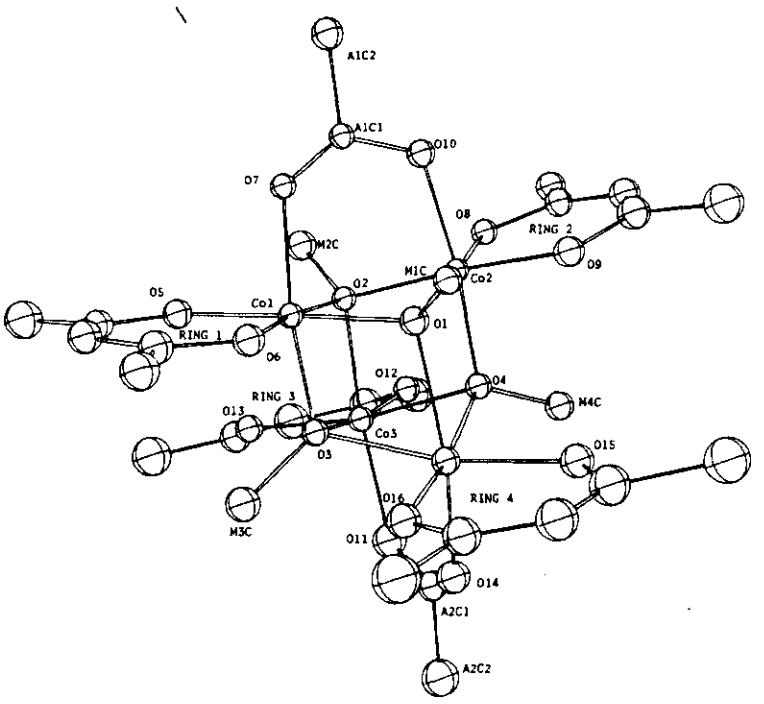


Figure 1. A Perspective Drawing of Co-Cubane

(2-aminoethoxido)cobalt(III)]cobalt(II), was reported by J. A. Bertrand, J. A. Kelley, and E. G. Vassian.[12] V. V. Vdovenko and A. N. Gerasenkova reported a series of trinuclear complexes with the formula $[Co_3(Eta)_6]X_2 \cdot nH_2O$.[13,14] One cobalt(II) and two cobalt(III) ions per formula unit were indicated by pontentiometric analyses for cobalt(II) and for total cobalt, and a structure with face-sharing octahedra was proposed. The structural study of the trinuclear cobalt complex above confirmed both the face-sharing arrangement and the octahedral coordination of the terminal cobalt (III) ions (Figure 2). However, the six alkoxide oxygens coordinated to the central cobalt(II) in an almost perfect trigonal prismatic arrangement. The magnetic moment (4.05 B.M.) was consistent with three unpaired electrons and was temperature-independent.

Another polynuclear cobalt complex, $NaCo_6[(DetaH_2)_6-7H](OH)_4(CO_3)_3 \cdot 12H_2O$, was prepared by A. Yao[15] and a structural study was attempted. The ratio of cobalt(II) to cobalt(III) was 2:1 and a portion of the structure revealed an arrangement of cobalt atoms similar to the tetrameric unit present in titanium alkoxides (Figure 3).[16-19] Two cobalt atoms were not located due to twinning, disordered atoms, and/or poor data.

The possibility of exchange coupling in the previously mentioned $[Co(Dma)(Dma-H)B]ClO_4$ compounds was not considered by Uhlig and Dinjus. However, the oxime groups of

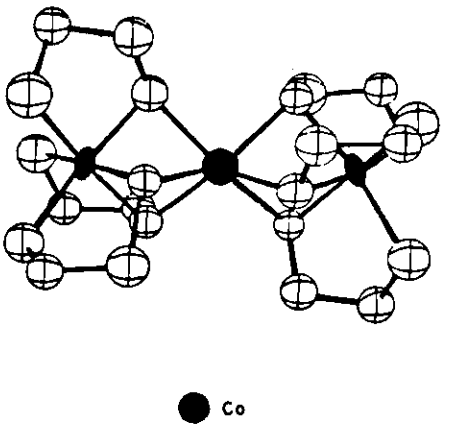


Figure 2. Structure of the Trinuclear Cobalt(II)-Cobalt(III) Complex of 2-Aminoethanol

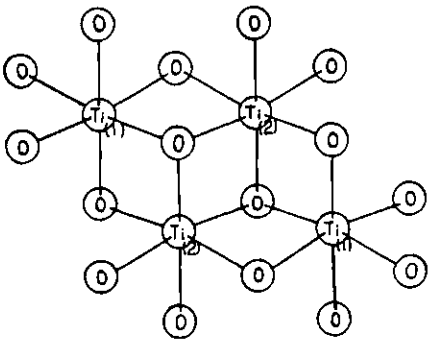


Figure 3. Structure of Titanium Alkoxides

similar ligands have formed bridges between metal ions and some of the resulting compounds exhibit spin coupling. For example, the structure of bis(dimethylglyoximato)copper(II), $Cu(dmgH)_2$, was reported by A. Vaciago and L. Zamibonelli,[20] and that of bis(4,4,9,9-tetramethyl-5,8-diazadodecane-2,11-dione-2oxime-μ-11-oximato)dicopper(II)bromide, Cu(4499)Br, by J. W. Fraser, G. R. Hedwig, H. K. J. Powell, and W. T. Robinson.[21] A dimeric nickel complex, bis[N-(6-amino-4-aza-3,3,6-trimethyl-2-heptylidenyl)hydroxanato]pentaaquo dinickel (II)chloride or Ni(NAH)Cl · $2.5H_2O$, was reported by E. O. Schlemper and R. K. Murmann,[22] and a complex with a reduced magnetic moment, μ_3-hydroxo-tri-μ-(pyridine-2-carbaldehyde oximato)-μ_3-sulphato-tricopper(II)-16.3 water or $[Cu_3(pyal)_2 OH]SO_4 \cdot 16.3H_2O$, was reported by R. Beckett and B. F. Hoskins.[23]

Several interesting oxime-bridged copper complexes have been reported using imine ligands derived from 2,3-butanedione monoxime. The synthesis of $Cu(L2py)ClO_4$ was reported by V. E. Uhlig and D. Schneider in 1964.[24] A. V. Ablov and N. I. Belichuk reported $Cu(L2a\ell)ClO_4 \cdot H_2O$.[25] And in 1974, the synthesis of $[Cu(Let)_3O]ClO_4$ and $[Cu(L2dea)(ClO_4)]_2 \cdot H_2O$ was reported by J. G. Mohanty, S. Baral, R. P. Singh, and A. Chakravorty.[26] Also, $Cu(LOsc)(ClO_4)$ was reported by A. V. Ablov and N. I. Belichuk.[27]

More recently, several new complexes involving imine ligands derived from 2,3-butanedione monoxime have been

synthesized and studied. $Cu(L3a\ell)(ClO_4) \cdot H_2O$, $Cu(L3am)(ClO_4)$, and Cu(LOdts)Br have been synthesized.[2] In addition, structures have been reported for $Cu(L2am)(ClO_4)$,[28] $Cu(L3LH)(ClO_4) \cdot \frac{1}{2}CH_3OH$,[29] and the previously reported $Cu(L2a\ell)(ClO_4) \cdot H_2O$[30] and $Cu(L2py)(ClO_4) \cdot CH_3CN$.[28]

Thus, the magnetic properties of the compounds reported by Uhlig and Dinjus could result from metal-metal bonds, exchange coupling, or mixed-valence. In order to determine the actual cause of the unusual magnetic moments, a structural study was undertaken.

CHAPTER II

EXPERIMENTAL

Preparation of $[Co_3(Dma)_6](ClO_4)_2$

The method of Uhlig and Dinjus[9] for the synthesis of $[Co(Dma)(Dma\text{-}H)(C_5H_5N)]ClO_4$ or $[Co(Dma)(Dma\text{-}H)(C_6H_5NH_2)]ClO_4$ yielded a red brown powder. Dark red prismatic crystals were obtained by recrystallization from absolute ethanol. Anal. Calc'd for $Co_3(C_{60}H_{66}N_{12}O_6)(ClO_4)_2$: C, 50.50; H, 4.67; N, 11.78; Cl, 4.97. Found: C, 47.35; H, 4.92; N, 11.05; Cl, 5.45. Elemental analyses were performed by Atlantic Microlab, Inc. in Atlanta, Georgia.

Crystallographic Studies

Crystallographic Data Collection

Since crystals of the compound lost weight and cracked upon exposure to air, the data were collected on crystals sealed in epoxy. The observation of a significant drop in the intensities of three standard reflections required that data be collected on two crystals. The data set from one crystal was scaled to that of the other by a comparison of standard reflections.

A red (epoxy coated) crystal with approximate dimensions .30 x .40 x .70 mm. (.50 x .50 x 1.15 for the second crystal) was mounted on a glass fiber using epoxy cement

such that the longest crystal dimension was approximately parallel to the fiber axis.

Unit cell parameters and the orientation matrix were determined on a Syntex $P2_1$ four circle diffractometer equipped with a graphite monochromator (Bragg 2θ angle = 12.2°) using MoK_α radiation at a takeoff angle of 6.75°. Fifteen reflections whose 2θ values ranged from 6.03° to 19.24° (5.75° to 22.60° for the second crystal) were machine-centered and used in least-squares refinement of the lattice parameters and orientation matrix. Unit cell parameters obtained were a = 17.81(2)Å,[31] b = 15.056(4)Å, c = 28.37(2)Å, β = 92.06(6)°, and V = 7604(9)Å^3 [a = 17.81(1)Å, b = 15.06(4) Å, c = 28.37(3)Å, β = 92.05(7)°, and V = 7605(10)Å^3 for the second crystal]. The calculated density of 1.25 g cm^{-3} for four formula units per unit cell does not agree with the experimental density of 1.39 g cm^{-3} measured by the flotation method using a mixture of ethanol and carbon tetrachloride. Omega scans of several low 2θ angle reflections gave peak widths at half-height of less than .29°, indicating a satisfactory mosaic spread for the crystal (also .29° for the second crystal).

Intensity data for zero and upper levels were collected at a rapid scan rate and the intensities examined carefully for systematic absences. The absence of h0ℓ reflections with ℓ = 2n + 1 and 0k0 reflections with k = 2n + 1 is consistent only with space group $P2_{1/c}$ (No. 14).[32]

Intensity data were collected using θ-2θ scans with x-ray source and monochromator settings identical to those used for determination of the unit cell parameters. A variable scan rate of from 4.88° to 29.30° min (5.86° to 29.30° min for the second crystal) was used and a scan width of 2.00° was sufficient to collect all of the peak intensity. Stationary background counts were measured at the beginning (bgd1) and at the end (bgd2) of each scan with a total background to scan time ratio, TR, of 1.0. No significant fluctuations were observed in the intensities of three standard reflections (4,0,0; 0,4,0; 0,0,4) monitored every 97 reflections (except when the first crystal failed and the remainder of the data were collected using a second crystal). Intensities were calculated from the total scan count (CT) and background counts by the relationship:

$$I = CT-(TR)(bgd1 + bgd2).$$

The intensities were assigned standard deviations according to the formula

$$\sigma(I) = [CT + (TR)^2(bgd1 + bgd2)]^{\frac{1}{2}}$$

from a total of 14391 reflections collected in a complete quadrant ($-h \rightarrow h$, $o \rightarrow k$, $o \rightarrow \ell$) of data out to $2\theta = 50.0°$; 4079 were accepted as statistically above background on the basis that I was greater than $3\sigma(I)$. Lorentz and polarization corrections were made in the usual way.

Solution and Refinement of the Structure

Computations were performed using standard programs;[33]

all computations were carried out on the CDC Cyber 74 System. For structure factor calculations the scattering factors were taken from Cromer and Waber's tabulation[34] for all atoms except hydrogen; Stewart's hydrogen atom scattering factors[35] were used. The scattering factors for Co, Cl were corrected for the real and imaginary anomalous dispersion components, using the dispersion factors given by Cromer.[36] The agreement factors are defined in the usual way as

$$R = (\Sigma||F_o|-|F_c||)/(\Sigma|F_o|)$$

and

$$R_w = [\Sigma_w(|F_o|-|F_c|)^2/\Sigma_w(|F_o|)^2]^{\frac{1}{2}}$$

In all least squares refinements, the quantity minimized was $w(|F_o|-|F_c|)^2$. A weighting scheme based on counting statistics ($w = 4I/\sigma^2(I)^2$) was employed for calculating R_w and in least-squares refinement.

Coordinates for two cobalt atoms were obtained from a three-dimensional Patterson synthesis. Two cycles of full-matrix least-squares refinement of the coordinates and isotropic temperature factors for these atoms resulted in R of 0.48 and R_w of 0.477. The remaining cobalt, oxygen, nitrogen, carbon, and chlorine atoms were located by means of subsequent difference Fourier calculation and least-squares refinement. A refinement using the weighting scheme and using anisotropic temperature factors for cobalt, chlorine, oxygen, and nitrogen atoms was used. The six phenyl rings were refined as rigid groups varying x,y,z of the center of the ring and three

orientation angles. The temperature factors for carbon were varied individually. Similarly, the two perchlorate groups were refined as rigid groups varying the oxygen temperature factors independently and the position of the group as a whole. One of the perchlorate groups was refined as two half groups due to disorder. The positions for hydrogen were calculated and the phenyl hydrogens refined as part of the groups. Neither the hydrogen coordinates not the thermal parameters (fixed at 5.0) were varied. The refinement converged to final values of $R = 0.087$ and $R_w = 0.097$. In the final cycle of refinement, the maximum parameter shift was 0.009σ (Z coordinate of Co3). The major feature on a final difference Fourier map was a peak of 1.35 $e\text{Å}^{-3}$. This position was not located near any atoms in the structure and would not refine. The final structural parameters are listed in Table 3 and the final observed and calculated structure factors are listed in Table 4.

Table 3. Positional and Thermal Parameters for $[Co_3(Dma)_6](ClO_4)_2$

ATOM	X	Y	Z	B11	B22	B33	B12	B13	B23
CO1	.19633(9)	.1140(1)	.22042(7)	2.65(8)	3.0(1)	2.49(9)	-.16(9)	.01(7)	.13(9)
CO2	-.16147(9)	.1057(2)	.09923(7)	2.49(8)	3.6(1)	2.54(9)	-.25(8)	-.10(7)	.05(9)
CO3	.1171(1)	.1067(2)	.15491(7)	2.65(8)	3.6(1)	2.92(9)	-.05(9)	-.19(6)	-.1(1)
CL1	-.3721(3)	.1630(4)	.3142(2)	6.7(3)	6.2(3)	6.1(3)	.1(2)	.8(2)	-.7(3)
CL2	.1-851-)	.1498(5)	.4567(2)	10.7(4)	9.4(4)	6.2(3)	2.8(3)	2.8(3)	-.3(3)
L1O1	-.1538(5)	-.0078(7)	.1402(4)	3.4(5)	4.2(6)	4.1(6)	.1(4)	-1.3(4)	.3(5)
L2O1	-.1764(5)	.1749(7)	.1773(4)	2.6(4)	4.9(6)	3.6(5)	-.4(4)	.8(4)	-1.2(5)
L3O1	-.0118(5)	.1483(7)	.0813(4)	2.6(4)	4.7(6)	4.0(6)	.3(4)	.3(4)	.5(5)
L4O1	.1858(5)	.2214(7)	.1561(4)	2.9(4)	3.8(5)	3.5(5)	.5(4)	.1(4)	.7(4)
L5O1	.0462(5)	.0771(7)	.2217(3)	3.3(4)	4.4(6)	2.6(5)	-.5(4)	-.5(3)	.3(4)
L6O1	.1485(5)	.0295(6)	.1294(3)	2.8(4)	3.2(5)	3.1(5)	-.3(4)	-.9(3)	-.3(4)
L1N1	-.1773(6)	.0598(9)	.3336(4)	3.4(5)	4.3(7)	2.6(6)	.4(5)	.3(4)	-.4(5)
L1N6	-.1957(6)	.0356(8)	.1033(4)	2.7(5)	3.1(6)	3.5(6)	-.2(5)	.8(5)	-.1(5)
L2N1	-.2439(6)	.0401(8)	.1277(4)	3.0(5)	3.9(7)	2.3(6)	-.1(5)	-.2(4)	.2(5)
L2N6	-.1384(5)	.1329(8)	.1637(4)	2.1(5)	4.1(7)	2.9(5)	.1(4)	.2(4)	-.4(5)
L3N1	-.2162(6)	.2186(8)	.0895(4)	2.4(5)	4.0(7)	3.2(6)	-.2(5)	-.2(4)	.3(5)
L3N6	-.0804(6)	.1795(9)	.0885(4)	2.7(5)	4.6(7)	2.6(6)	.1(5)	-.8(4)	-.3(5)
L4N1	.2034(6)	.1224(8)	.1596(4)	3.2(5)	3.5(7)	3.1(6)	-.6(5)	.2(4)	.2(5)
L4N6	.1559(6)	.1956(8)	.1558(4)	2.3(5)	3.0(6)	3.3(6)	.5(4)	.8(4)	.5(5)
L5N1	.2272(6)	.2104(8)	.2445(4)	2.8(5)	4.0(7)	2.9(6)	-.3(5)	.1(4)	-.1(5)
L5N6	.1079(5)	.1210(8)	.2347(4)	2.6(5)	3.1(6)	2.6(5)	.0(5)	-.8(4)	.2(5)
L6N1	.2377(6)	.0158(8)	.2398(4)	3.1(5)	3.6(6)	2.1(6)	.3(5)	-.7(4)	.2(5)
L6N6	.1559(6)	.0176(8)	.1656(4)	2.6(5)	2.7(6)	3.8(6)	.5(4)	.1(4)	-.3(5)

ATOM	X	Y	Z	B
L1C2	-.1392(8)	-.011(1)	.0260(6)	3.8(3)
L1C3	-.141(1)	-.163(1)	-.0231(7)	5.7(4)
L1C4	-.0885(8)	-.043(1)	.0649(6)	3.5(3)
L1C5	-.031(1)	-.114(2)	.0622(7)	6.2(4)
L2C2	-.2424(7)	.047(1)	.1736(5)	3.2(3)
L2C3	-.3033(9)	.103(1)	.2444(6)	4.2(3)
L2C4	-.1814(7)	.098(1)	.1946(5)	3.3(3)
L2C5	-.1665(9)	.139(1)	.2476(6)	5.2(4)
L3C2	-.1748(8)	.282(1)	.0767(6)	4.1(3)
L3C3	-.199(1)	.376(1)	.0678(7)	6.2(4)
L3C4	-.0965(8)	.259(1)	.0702(6)	3.4(3)
L3C5	-.036(1)	.327(1)	.0553(7)	5.6(4)
L4C2	.2714(8)	.180(1)	.1262(6)	3.6(3)
L4C3	.3288(9)	.196(1)	.0862(7)	5.4(4)
L4C4	.2093(8)	.222(1)	.1228(6)	3.6(3)
L4C5	.1726(9)	.286(1)	.0837(7)	5.2(4)
L5C2	.1779(8)	.225(1)	.2753(6)	3.9(3)
L5C3	.1854(9)	.295(1)	.3145(7)	5.3(4)
L5C4	.1381(8)	.175(1)	.2706(6)	3.6(3)
L5C5	.0389(9)	.186(1)	.3004(7)	4.9(4)
L6C2	.2177(8)	-.060(1)	.2238(6)	3.6(3)
L6C3	.240(1)	-.149(1)	.2469(7)	5.0(4)
L6C4	.1703(8)	-.063(1)	.1817(5)	3.3(3)
L6C5	.135(1)	-.144(1)	.1587(7)	5.8(4)

Table 4. Observed (FO) and Calculated (FC) Structure Factors for

$[Co_3(Dma)_6](ClO_4)_2$

K	L	FO	FC
	H=-20		
0	8	44	42
0	12	56	55
1	9	49	43
2	11	39	42
	H=-19		
0	6	44	49
0	8	41	43
1	5	50	53
1	8	41	40
1	9	52	53
2	7	76	75
2	11	37	38
3	4	46	49
3	8	58	57
3	9	48	45
3	10	46	44
4	6	57	56
4	8	56	56
4	12	44	42
5	5	38	36
5	9	55	54
6	6	38	28
6	7	45	46
	H=-18		
0	2	36	34
0	6	96	99
0	8	69	65
1	4	51	49
1	5	48	49
1	9	37	33
2	3	36	34
2	5	50	52
2	7	79	76
3	4	85	82
3	5	53	43
4	2	45	46
4	3	39	42
4	6	55	58
4	8	56	54
5	3	50	55
5	5	76	73
5	6	36	32
6	3	37	40
6	7	48	48
7	4	63	63
8	2	38	41
8	7	41	34
9	5	39	40

K	L	FO	FC
	H=-17		
0	2	33	36
0	12	38	35
0	18	45	51
1	4	34	38
1	19	47	50
1	20	44	41
1	21	48	44
2	1	45	42
2	3	33	30
3	3	41	43
3	20	55	49
4	2	78	74
5	1	82	80
5	3	36	34
6	2	54	53
6	3	43	50
7	4	48	49
8	1	50	49
9	1	43	40
9	3	40	37
10	2	40	40
	H=-16		
0	8	42	39
0	10	46	49
0	12	39	40
0	16	79	76
0	18	93	92
1	2	43	46
1	3	43	40
1	13	37	34
1	14	41	38
1	15	49	48
1	19	62	60
1	20	39	40
2	9	42	37
2	17	77	76
2	18	40	35
3	16	42	38
3	20	47	43
4	9	33	32
4	16	38	41
4	18	48	48
5	15	42	40
5	19	43	41
6	17	43	40
7	14	48	45
8	1	47	45
9	15	49	48
	H=-15		
0	2	41	42

K	L	FO	FC
0	4	71	75
0	8	72	73
0	12	87	86
0	14	57	54
0	18	42	43
1	4	40	39
1	7	46	44
1	10	61	61
1	11	48	47
1	15	63	65
1	17	38	38
2	10	39	36
2	11	36	43
2	13	70	67
2	17	46	48
3	1	32	26
3	3	56	58
3	8	40	34
3	14	43	38
3	16	40	43
4	1	36	32
4	2	35	39
4	7	35	32
4	9	36	37
4	12	47	45
5	11	33	33
5	15	44	42
6	1	36	32
6	13	48	45
7	5	34	36
7	10	50	46
7	14	55	52
7	16	42	43
8	9	37	32
8	12	42	42
8	13	47	48
9	11	55	52
9	15	59	56
10	12	47	48
	H=-14		
0	2	44	45
0	4	60	64
0	8	113	114
0	12	63	64
0	14	34	41
0	16	36	41
1	1	44	43
1	4	30	21
1	6	42	40
1	7	39	35
1	9	82	78
1	10	84	82
1	11	39	45
2	1	51	52

K	L	FO	FC
2	7	56	63
2	9	65	64
2	13	53	52
2	14	33	36
3	2	36	35
3	6	51	50
3	9	59	59
3	10	57	56
3	11	35	38
3	17	33	30
3	20	37	37
4	3	55	52
4	8	40	39
4	9	37	32
4	11	35	38
4	12	38	34
5	1	37	41
5	5	32	39
5	7	40	39
5	11	39	37
6	7	43	41
6	8	54	56
6	11	36	40
6	13	36	34
7	6	48	47
7	10	76	77
7	14	34	31
7	20	45	42
8	7	45	41
8	8	37	37
8	9	44	42
8	11	37	39
8	12	59	62
9	7	36	39
9	9	42	44
9	11	63	57
10	8	62	65
10	12	49	51
11	10	45	46
12	9	37	32
	H=-13		
0	2	47	39
0	4	70	69
0	6	76	71
0	8	103	102
0	12	33	35
0	14	34	26
0	16	33	29
1	4	36	31
1	5	119	117
1	6	98	99
1	7	45	44
1	9	56	46
1	13	49	46

K	L	FO	FC
1	14	67	67
1	15	54	56
1	17	32	29
1	18	36	40
1	25	40	40
2	2	29	29
2	3	115	112
2	7	84	89
2	9	63	59
2	10	36	35
2	12	39	42
2	23	47	44
3	4	84	89
3	5	70	69
3	6	103	101
3	7	35	36
3	10	61	60
3	13	42	39
3	16	48	48
3	24	40	37
3	26	41	38
4	2	38	40
4	4	50	52
4	6	49	55
4	7	54	55
4	8	100	97
4	11	43	41
4	12	40	35
4	18	37	34
5	1	33	24
5	4	31	35
5	5	121	124
5	6	53	55
5	7	59	56
5	9	73	70
5	25	53	50
6	1	42	44
6	2	31	35
6	3	70	70
6	4	44	43
6	6	32	29
6	7	88	87
6	8	82	84
6	9	50	54
6	11	36	40
6	17	46	47
7	4	82	85
7	6	92	99
7	9	34	36
7	10	71	72
8	3	39	41
8	4	32	36
8	7	78	80
8	8	70	69
8	9	41	45
8	10	36	34

K	L	FO	FC
9	5	62	64
9	7	40	41
9	9	51	53
10	2	43	42
10	8	61	57
11	4	34	34
11	10	43	39
12	7	42	43
13	5	42	36
	H=-12		
0	2	165	164
0	4	147	150
0	6	112	120
0	8	56	55
0	10	44	49
0	12	97	96
0	14	54	55
0	18	58	57
0	22	59	58
1	1	122	130
1	2	123	120
1	3	31	23
1	4	45	48
1	5	120	125
1	6	78	82
1	10	58	53
1	11	34	31
1	16	39	45
1	23	40	38
1	21	45	45
2	1	80	79
2	3	172	177
2	4	27	20
2	7	61	61
2	9	31	29
2	13	46	45
2	14	70	75
2	16	43	34
2	19	59	58
2	23	40	46
3	1	77	71
3	2	56	64
3	3	32	35
3	4	70	80
3	5	32	32
3	6	86	84
3	8	28	32
3	9	30	24
3	10	40	41
3	11	40	47
3	20	63	63
3	21	38	36
3	22	54	55
4	2	105	103

K	L	FO	FC
4	3	28	35
4	4	82	82
4	7	40	46
4	8	57	58
4	16	53	51
4	18	35	36
4	22	65	62
5	1	93	94
5	2	39	40
5	5	130	126
5	7	43	47
5	8	32	27
5	17	34	35
5	19	40	38
5	21	77	78
5	25	46	46
6	1	43	37
6	3	104	106
6	4	59	57
6	7	57	59
6	17	35	32
6	18	40	40
6	19	40	42
6	23	61	64
7	2	39	37
7	4	89	91
7	6	84	87
7	11	35	34
7	20	56	57
7	22	44	41
7	24	37	32
8	2	63	65
8	3	35	39
8	4	38	39
8	7	34	32
8	8	42	42
8	22	44	45
8	23	45	42
8	24	40	39
9	1	53	56
9	3	39	37
9	5	40	38
9	7	36	36
9	21	42	39
10	2	35	32
10	4	33	26
10	5	33	35
11	6	39	43
12	3	61	61
13	1	49	52
14	2	40	38
14	4	39	39
	H=-11		
0	2	93	88

K	L	FO	FC
0	4	121	125
0	8	55	58
0	10	86	85
0	18	47	54
1	1	113	118
1	2	102	118
1	4	56	58
1	5	75	80
1	7	31	28
1	10	43	48
1	11	50	56
1	13	50	49
1	15	33	41
1	21	48	46
2	2	34	31
2	3	123	118
2	6	59	55
2	7	39	43
2	15	35	31
2	17	43	36
2	19	56	62
2	23	34	31
2	21	34	31
3	1	60	60
3	2	93	94
3	3	48	46
3	4	58	61
3	11	28	23
3	15	40	38
3	16	87	85
3	17	48	48
3	20	96	98
3	21	43	38
4	1	32	42
4	2	75	76
4	3	68	65
4	4	75	77
4	6	27	28
4	12	41	42
4	18	169	169
4	19	53	52
4	22	51	56
5	1	139	145
5	2	65	62
5	7	46	49
5	8	28	28
5	12	49	50
5	13	38	38
5	16	53	56
5	17	75	76
5	19	82	79
5	21	93	93
6	1	32	32
6	2	51	46
6	3	58	56
6	8	65	66

Table 4. (Continued)

K	L	FO	FC
6	9	43	46
6	17	86	90
6	18	36	41
6	19	77	74
6	23	39	46
7	2	50	45
7	5	35	32
7	6	35	36
7	7	32	31
7	16	44	47
7	20	63	62
7	22	54	54
8	1	30	38
8	6	31	33
8	7	40	40
8	10	39	35
8	13	36	35
9	1	56	53
9	3	35	40
9	8	35	41
9	21	55	53
10	11	37	41
11	2	35	40
11	12	34	32
11	20	48	42
12	3	42	39
12	9	37	33
12	17	37	37
13	1	68	66
14	2	37	35
H=-10			
0	8	59	55
0	10	115	115
0	12	60	59
0	14	156	155
0	18	120	118
1	1	65	64
1	2	88	82
1	3	32	26
1	4	51	46
1	5	49	51
1	6	85	83
1	7	97	96
1	10	36	29
1	12	53	48
1	15	82	82
1	16	42	43
1	17	42	42
1	19	39	37
1	21	38	38
2	2	70	63
2	3	45	51
2	6	37	37
2	7	29	32
2	8	50	50
2	10	73	66
2	12	69	69
2	13	66	69
2	15	51	53
2	16	36	40
2	17	93	89
2	19	49	57
3	1	93	94
3	2	53	48
3	3	44	47
3	5	36	38
3	6	61	60
3	7	33	27
3	8	27	24
3	9	78	68
3	14	55	56
3	16	83	85
3	19	31	32
3	20	53	49
4	1	46	51
4	4	42	45
4	7	33	33
4	11	28	22
4	12	32	31
4	13	33	37
4	14	116	122
4	17	46	53
4	18	77	78
4	19	41	39
5	1	40	44
5	2	71	69
5	5	54	55
5	6	52	51
5	11	52	50
5	13	31	34
5	14	35	35
5	15	118	118
5	17	80	83
5	19	34	30
6	1	50	50
6	2	20	19
6	3	31	39
6	6	43	47
6	7	43	45
6	10	63	65
6	13	34	32
6	14	40	42
6	17	53	49
6	18	53	52
6	19	35	37
7	2	32	36
7	6	48	52
7	7	31	42
7	10	32	38
7	12	33	36
7	16	71	66
7	20	35	32
8	2	46	44
8	7	49	56
8	8	45	52
8	10	34	37
8	13	36	40
9	3	44	41
9	5	31	26
9	7	49	50
9	9	36	42
9	15	36	32
10	1	34	36
10	7	39	39
10	8	48	46
10	11	48	49
11	6	51	52
11	9	35	34
11	10	39	43
11	12	36	36
11	15	36	36
11	16	57	56
12	13	61	62
13	5	45	42
13	15	48	41
13	16	41	40
14	14	45	40
H= -9			
0	2	58	55
0	4	68	70
0	6	69	66
0	8	126	121
0	10	129	132
0	12	41	42
0	14	141	146
0	20	42	37
1	1	29	26
1	2	59	67
1	4	41	21
1	5	38	40
1	14	45	47
1	11	157	157
1	12	74	72
1	13	35	38
1	14	62	62
1	15	74	71
1	16	59	57
1	17	41	40
2	3	56	57
2	5	35	40
2	6	41	32
2	7	92	84
2	9	47	42
2	12	33	38
2	13	101	102
2	15	80	79
2	17	48	47
2	19	35	33
2	29	36	35
3	2	28	18
3	3	43	44
3	4	85	79
3	6	70	68
3	7	43	34
3	8	36	35
3	10	82	84
3	11	35	47
3	12	81	79
3	16	64	63
3	17	43	38
3	25	37	29
3	30	50	45
4	2	83	72
4	5	80	81
4	8	92	98
4	9	55	61
4	10	27	35
4	11	27	28
4	12	47	45
4	13	56	66
4	14	96	99
4	17	37	39
4	20	31	22
4	28	37	35
5	1	126	135
5	2	87	84
5	4	38	44
5	5	35	38
5	6	68	77
5	7	96	96
5	8	26	24
5	9	43	45
5	10	34	38
5	11	103	104
5	15	66	66
5	18	32	36
5	21	53	45
6	3	37	44
6	4	40	41
6	5	53	45
6	6	87	88
6	9	58	56
6	12	82	82
6	13	108	104
6	14	41	45
6	16	42	42
7	2	44	38
7	3	32	33
7	4	30	38
7	7	50	54
7	9	30	28
7	9	32	34
7	10	52	51
7	12	94	96
7	13	40	45
7	14	38	44
7	16	38	36
8	4	31	33
8	9	46	40
8	12	53	55
8	13	47	55
8	14	43	45
9	1	30	27
9	6	35	31
9	9	54	52
9	11	72	78
9	13	57	52
10	1	83	89
10	3	62	58
10	5	41	40
10	7	34	36
10	8	33	42
10	12	55	51
10	13	40	34
10	14	35	34
11	9	34	24
11	10	85	91
11	12	65	62
12	2	55	53
12	4	46	48
12	9	71	69
12	13	69	69
13	1	39	32
13	11	53	54
14	5	41	38
14	12	46	41
14	14	56	47
H= -8			
0	2	83	80
0	4	114	114
0	8	217	201
0	10	148	168
0	14	29	29
0	16	28	27
0	18	79	79
0	28	45	40
0	30	40	38
1	1	51	49
1	2	97	88
1	5	180	178
1	6	88	90
1	7	200	205
1	8	143	139
1	11	74	82
1	11	121	119
1	12	40	44
1	13	47	50
1	15	34	34
1	20	34	38
2	1	29	32
2	2	52	56
2	3	47	55
2	4	45	45
2	5	76	69
2	7	110	110
2	8	53	57
2	9	150	138
2	10	36	28
2	11	35	37
2	12	33	29
2	13	69	73
2	19	58	60
2	27	39	38
2	29	57	58
3	1	27	39
3	2	74	65
3	3	56	53
3	4	42	45
3	5	104	95
3	6	194	194
3	7	98	103
3	8	36	39
3	10	104	115
3	11	86	85
3	12	74	68
3	26	38	39
3	27	36	35
3	30	46	46
4	1	43	32
4	4	188	179
4	5	131	115
4	6	51	43
4	8	166	159
4	9	41	48
4	10	52	55
4	14	58	54
4	18	41	46
4	28	55	54
5	2	47	50
5	3	78	70
5	4	83	74
5	5	101	98
5	6	91	89
5	7	109	110
5	8	29	31
5	9	73	75
5	10	59	62
5	11	87	93
5	13	30	32
5	14	56	50
5	17	32	30
5	25	46	47
5	27	51	50
6	1	52	54
6	3	45	47
6	4	33	36
6	5	46	41
6	6	61	68
6	7	58	66
6	8	64	69
6	9	114	121
6	11	32	31
6	12	42	42
6	13	29	19
6	17	56	59
6	18	32	35
7	2	81	76
7	4	43	35
7	6	33	35
7	8	53	58
7	10	94	92
7	12	60	60
7	13	48	47
7	15	73	74
7	16	53	51
7	26	51	52
8	1	58	59
8	5	39	36
8	8	54	58
8	9	66	67
8	10	71	69
8	16	39	38
8	18	32	31
9	1	38	48
9	5	56	54
9	7	57	57
9	11	43	49
9	13	37	37
9	14	43	42
9	25	36	32
10	7	75	78
10	8	106	105
10	9	65	61
10	10	56	55
10	11	48	54
11	6	97	102
11	8	39	41
11	10	59	59
11	12	70	65
12	1	37	38
12	7	69	77
12	8	69	61
12	9	116	115
12	10	51	49
12	13	47	48
13	4	36	35
13	5	51	46
13	6	54	56
13	7	55	58
13	10	38	37
13	11	55	55
H= -7			
0	2	82	92
0	4	266	261
0	8	153	137
0	10	152	151
0	12	62	68
0	16	56	55
0	18	36	33
0	20	92	91
0	22	32	40
0	24	34	30
1	1	98	82
1	2	112	101
1	5	113	112
1	6	119	120
1	7	194	203
1	8	93	84
1	9	76	74
1	10	32	42
1	11	34	35
1	12	37	40
1	15	38	31
1	22	32	38
1	23	58	44
1	26	67	61
1	27	37	38
2	2	110	104
2	3	217	220
2	4	58	55
2	5	114	101
2	6	58	61
2	7	68	68
2	9	152	152
2	11	48	42
2	12	25	33
2	13	35	35
2	14	36	38
2	15	34	29
2	16	39	35
2	17	61	64
2	19	45	44
2	21	49	55
2	23	56	52
3	1	33	29
3	2	92	110

Table 4. (Continued)

K	L	FO	FC
3	3	103	102
3	4	59	53
3	5	51	63
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3	7	126	134
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3	10	36	22
3	11	27	32
3	13	26	28
3	17	34	26
3	19	38	28
3	22	57	59
3	26	58	53
3	27	43	40
4	1	67	73
4	3	69	61
4	4	231	233
4	5	38	49
4	7	55	57
4	8	130	116
4	10	40	45
4	14	29	35
4	20	42	38
4	22	40	42
4	24	59	58
5	1	160	149
5	2	63	61
5	3	145	144
5	5	182	175
5	6	86	89
5	7	140	141
5	8	43	46
5	14	51	54
5	15	44	44
5	18	41	48
5	20	33	28
5	21	47	43
6	1	71	69
6	3	105	99
6	4	109	119
6	5	73	72
6	7	52	55
6	8	64	69
6	9	40	40
6	13	32	35
6	14	66	74
6	15	60	56
6	23	57	55
6	24	50	49
6	28	37	37
7	2	69	72
7	3	32	30
7	6	143	143
7	7	45	43
7	8	29	36
7	10	52	46
7	11	31	40
7	13	33	33
7	16	59	63
7	19	37	36
7	22	51	53
7	26	55	55
8	3	28	36
8	4	59	65
8	5	92	87
8	7	36	33
8	8	40	35
8	9	38	37
8	12	64	67
8	13	51	45
8	14	77	78
8	15	40	46
8	23	41	42
8	24	47	41
8	25	39	46
9	3	34	38
9	5	56	57
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9	10	39	33
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9	25	42	49
9	27	38	36
10	3	30	29
10	4	62	64
10	5	70	67
10	7	36	35
10	8	39	39
10	11	61	60
10	13	75	74
10	15	39	39
10	24	47	47
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11	8	78	79
11	11	46	44
12	3	40	41
12	4	33	35
12	5	88	82
12	6	33	30
12	9	64	65
12	10	34	29
12	12	35	34
13	2	34	32
13	5	54	48
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13	7	58	64
14	4	60	58
14	8	55	51
15	6	40	38
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0	18	115	102
0	20	122	122
0	22	42	35
0	24	57	61
1	1	181	145
1	2	138	123
1	3	171	157
1	4	103	72
1	5	94	89
1	6	132	124
1	7	23	27
1	8	40	42
1	9	62	61
1	10	31	34
1	11	112	122
1	12	60	61
1	13	38	34
1	16	76	78
1	17	117	116
1	18	81	82
1	20	34	37
1	21	84	87
1	22	92	92
1	23	77	70
1	25	36	33
2	1	56	50
2	3	190	209
2	5	75	70
2	6	164	139
2	7	36	28
2	8	46	42
2	10	37	35
2	16	31	39
2	17	40	44
2	18	51	54
2	19	152	157
2	20	48	45
2	21	37	47
2	23	64	62
3	1	50	37
3	2	233	230
3	3	36	41
3	4	34	29
3	5	130	144
3	6	53	58
3	7	27	26
3	9	100	102
3	10	24	33
3	12	31	36
3	15	45	48
3	16	62	62
3	17	29	28
3	18	64	66
3	20	40	44
3	21	41	43
3	22	92	94
3	23	74	73
4	1	65	70
4	2	96	105
4	3	100	97
4	4	244	242
4	15	40	45
4	17	41	38
4	18	72	71
4	19	61	64
4	20	70	66
4	21	48	48
5	1	176	192
5	3	72	77
5	5	135	134
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5	7	29	14
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5	16	51	55
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5	21	50	54
5	22	39	35
6	1	32	39
6	2	29	33
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6	4	56	72
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6	8	34	36
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6	13	73	75
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6	17	48	48
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6	19	89	91
6	20	36	36
6	23	37	33
7	2	166	165
7	6	84	84
7	10	26	31
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7	12	95	96
7	13	64	64
7	18	32	30
7	20	36	39
7	22	67	72
8	1	60	63
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8	4	65	61
8	5	50	40
8	7	50	42
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8	12	61	62
8	14	48	46
8	20	47	45
8	23	49	52
9	1	153	147
9	2	37	38
9	3	85	88
9	5	54	55
9	7	51	51
9	9	34	30
9	10	47	45
9	11	61	59
9	21	57	49
10	3	30	24
10	4	66	72
10	10	38	36
10	20	37	31
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13	1	41	29
13	7	33	32
13	21	49	45
16	3	42	37
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0	10	150	167
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0	14	91	89
0	16	79	76
0	18	175	173
0	20	86	83
0	22	61	59
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1	2	178	149
1	3	143	123
1	4	96	83
1	5	75	84
1	6	79	63
1	7	53	75
1	8	95	85
1	9	25	24
1	10	32	40
1	11	30	17
1	13	107	110
1	16	80	89
1	17	111	118
1	21	63	61
1	22	45	37
2	1	62	14
2	2	44	44
2	4	27	24
2	5	47	55
2	6	61	68
2	7	94	80
2	8	157	139
2	9	80	84
2	10	41	31
2	11	128	138
2	12	112	106
2	13	35	25
2	14	45	38
2	15	98	108
2	17	64	66
2	19	195	197
3	1	163	155
3	2	189	164
3	3	47	40
3	4	27	20
3	5	89	98
3	6	123	110
3	9	98	81
3	10	34	39
3	11	43	37
3	13	75	67
3	14	52	45
3	16	149	143
3	18	91	93
3	20	39	36
3	21	47	49
3	22	35	35
3	27	37	34
4	2	98	98
4	3	98	95
4	4	35	40
4	6	92	80
4	7	130	119
4	8	47	43
4	10	56	62
4	11	60	62
4	12	45	42
4	13	44	45
4	14	72	73
4	15	42	50
4	16	34	27
4	17	37	39
4	18	124	114
4	20	112	117
5	1	277	259
5	2	69	85
5	3	92	100
5	4	29	25
5	5	102	87
5	6	48	50
5	7	58	61
5	8	73	79
5	9	26	20
5	12	48	46
5	15	125	128
5	17	134	138
5	19	35	37
5	21	60	59
5	22	32	37
6	2	67	76
6	3	77	84
6	4	86	102
6	5	68	73
6	8	30	29
6	12	48	42
6	14	60	55
6	15	102	112
6	17	36	40
6	19	110	110
6	27	36	33
7	2	89	100
7	9	31	30
7	13	71	69
7	15	35	35
7	16	146	144
7	18	72	69
7	20	49	53
7	26	34	31
8	2	49	59
8	3	65	61
8	8	37	45
8	14	98	91
8	15	72	69
8	18	38	36
9	1	63	71
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11	2	56	62
11	4	31	35
11	5	34	28
11	6	71	64
11	8	44	43
11	16	52	52
11	18	40	43
11	20	38	39
12	1	34	39
12	6	34	32
12	9	32	38
12	15	38	40
12	19	58	54
13	1	47	46
13	3	41	49
13	5	35	28
13	17	61	57
		H= -4	
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0	4	222	177
0	6	45	33
0	8	146	159
0	12	46	36
0	14	178	175
0	16	39	46
0	18	93	93
0	22	29	38
0	24	66	63
0	28	37	32
0	30	45	50
1	2	82	67
1	3	34	76
1	5	122	138
1	6	78	76
1	7	133	124
1	8	110	91
1	9	132	110
1	10	78	62
1	11	72	68
1	12	95	108
1	13	63	55
1	14	46	49
1	15	128	128
1	16	69	69
1	17	63	67
1	20	47	40
1	22	29	29
2	1	193	145
2	2	211	172
2	3	37	31
2	4	96	110
2	6	41	31
2	8	23	7
2	9	53	53
2	11	25	18
2	12	54	46
2	13	185	177
2	14	71	75
2	15	231	236
2	19	59	65
2	23	69	63
3	1	126	137
3	2	122	93
3	4	44	53

Table 4. (Continued)

K	L	FO	FC
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3	7	82	101
3	8	84	93
3	9	36	22
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3	12	170	175
3	13	59	60
3	14	50	46
3	16	135	136
3	17	71	78
3	18	90	85
3	21	32	23
3	32	60	55
4	2	116	115
4	3	60	50
4	4	29	9
4	5	43	26
4	6	54	43
4	7	125	143
4	8	25	50
4	9	22	18
4	10	29	25
4	11	83	78
4	13	49	54
4	14	210	220
4	16	125	122
4	18	94	88
5	1	107	97
5	3	23	30
5	4	53	60
5	5	28	19
5	6	23	40
5	10	39	56
5	11	44	42
5	12	50	55
5	13	135	140
5	15	52	55
5	17	152	154
5	19	47	44
6	1	29	30
6	2	55	54
6	3	23	15
6	6	80	73
6	7	30	16
6	8	28	38
6	9	36	32
6	13	125	139
6	14	107	107
6	15	134	134
6	16	41	44
6	17	38	39
6	19	39	39
7	1	66	58
7	2	39	39
7	3	24	20
7	5	37	37
7	6	27	24
7	7	38	41
7	8	26	36
7	10	61	65
7	12	170	171
7	14	56	55
7	16	72	70
7	18	88	91
7	19	37	26
8	4	25	27
8	7	41	47
8	8	51	53
8	10	43	53
8	11	60	60
8	13	75	78
8	14	95	101
8	15	55	52
8	16	46	46
8	17	46	51
8	19	45	45
9	4	40	36
9	9	34	28
9	11	84	85
9	13	119	115
9	15	63	63
9	16	33	25
9	17	87	91
10	1	35	28
10	4	46	43
10	5	53	55
10	8	34	21
10	10	74	68
10	13	34	40
10	14	92	95
10	15	43	51
11	2	78	71
11	4	43	39
11	5	53	53
11	10	41	34
11	12	84	88
11	16	54	55
11	18	33	30
12	3	47	50
12	5	68	72
12	13	41	43
13	3	32	38
13	4	34	33
13	6	31	30
13	11	32	33
13	17	38	36
14	14	39	32

H= -3

K	L	FO	FC
0	2	134	128
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0	6	24	45
0	8	105	134
0	10	162	166
0	12	43	62
0	14	274	252
0	16	37	39
0	20	48	44
0	28	61	59
0	30	75	81
1	1	81	71
1	2	90	126
1	3	143	173
1	4	108	89
1	7	97	89
1	8	67	80
1	9	50	37
1	10	72	86
1	11	123	132
1	12	105	107
1	13	157	146
1	15	28	40
1	16	45	41
1	17	44	53
1	18	62	57
1	19	47	49
1	21	35	42
1	22	44	42
1	24	46	48
1	27	54	54
1	31	48	47
2	1	138	76
2	2	105	95
2	3	96	92
2	4	44	81
2	5	330	304
2	6	65	20
2	7	22	24
2	8	94	75
2	9	104	100
2	11	108	110
2	12	45	40
2	14	37	37
2	15	87	87
2	16	42	41
2	18	56	63
2	19	80	79
2	21	76	72
2	22	39	47
2	28	37	36
2	29	62	71
2	31	44	48
3	2	96	112
3	3	229	202
3	4	122	86
3	5	81	70
3	6	43	59
3	7	29	53
3	8	33	52
3	9	93	79
3	10	49	60
3	11	113	119
3	12	156	147
3	13	75	62
3	14	30	37
3	15	27	42
3	16	66	74
3	19	37	45
3	20	75	74
3	22	63	59
3	23	71	69
3	28	44	44
3	32	50	50
4	1	132	85
4	2	89	78
4	3	26	24
4	5	109	85
4	6	94	110
4	8	75	67
4	9	68	70
4	10	128	138
4	11	74	79
4	13	110	115
4	14	87	82
4	17	105	101
4	18	53	67
4	19	76	82
4	20	123	123
4	23	36	31
4	30	43	45
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5	6	31	40
5	7	86	66
5	9	72	63
5	10	104	107
5	11	194	185
5	12	41	45
5	13	136	138
5	14	30	41
5	15	32	25
5	17	29	22
5	21	77	86
5	31	42	41
6	1	25	15
6	2	84	98
6	3	57	74
6	5	78	88
6	6	80	80
6	8	85	96
6	9	143	149
6	10	177	187
6	11	131	127
6	12	33	43
6	14	78	85
6	15	75	80
6	16	43	44
6	17	29	33
6	19	30	28
6	19	53	55
6	21	34	34
7	1	28	27
7	4	78	77
7	6	91	105
7	8	175	177
7	12	170	178
7	13	52	45
7	14	65	70
7	22	39	41
7	26	37	32
8	1	77	75
8	2	29	35
8	3	26	22
8	5	56	52
8	6	32	35
8	7	34	32
8	9	97	97
8	10	76	89
8	11	74	76
8	13	121	123
8	14	46	41
8	15	76	79
8	16	35	33
9	1	25	36
9	4	74	76
9	5	30	31
9	7	82	88
9	9	101	105
9	11	93	104
9	12	47	44
9	13	90	90
9	16	31	22
9	21	39	35
9	27	48	49
10	1	86	80
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10	4	31	33
10	5	58	56
10	6	47	54
10	9	44	43
10	10	121	112
10	12	52	54
10	13	38	43
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10	15	39	32
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11	2	91	93
11	3	67	74
11	4	31	39
11	5	45	45
11	6	57	58
11	7	64	54
11	8	95	98
11	10	31	38
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11	12	37	37
12	1	33	26
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12	8	35	32
12	9	86	83
12	13	35	31
13	1	34	34
13	6	33	33
13	7	33	28
13	13	35	33
14	10	54	47
16	9	50	51
16	11	36	35

H= -2

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0	4	259	248
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0	8	89	41
0	12	116	114
0	14	56	67
0	16	61	70
0	18	30	31
0	24	99	102
0	26	82	83
0	30	60	63
1	1	25	36
1	2	53	57
1	3	144	179
1	6	98	92
1	7	208	127
1	8	176	157
1	9	176	188
1	10	66	57
1	11	58	58
1	13	28	9
1	16	33	48
1	17	37	39
1	18	33	26
1	24	37	33
2	1	84	145
2	2	72	78
2	4	131	127
2	5	79	75
2	6	60	55
2	7	26	35
2	8	158	130
2	9	40	35
2	10	86	103
2	11	35	45
2	12	30	22
2	13	46	43
2	14	23	27
2	15	42	37
2	17	45	51
2	18	41	46
2	23	54	62
2	25	95	96
2	29	48	56
3	1	143	171
3	2	43	17
3	3	70	80
3	4	200	224
3	5	56	61
3	6	82	89
3	7	162	162
3	9	64	58
3	10	33	30
3	13	30	22
3	14	37	50
3	15	34	33
3	18	33	38
3	28	63	74
4	1	202	139
4	2	286	258
4	3	42	29
4	5	57	82
4	6	47	32
4	7	87	85
4	8	76	83
4	9	80	74
4	10	82	82
4	11	37	30
4	13	45	46
4	16	30	39
4	17	45	46
4	18	30	27
4	19	39	42
4	24	79	75
5	2	63	69
5	5	26	28
5	7	146	146
5	8	80	93
5	9	131	122
5	10	64	63
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5	16	56	54
5	17	84	83
5	20	39	35
5	22	43	38
6	1	143	159
6	2	27	15
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6	5	136	133
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6	7	36	49
6	8	45	49
6	9	60	68
6	10	66	69
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6	18	52	55
6	19	51	68
6	21	35	32
6	25	37	46
7	1	57	66
7	3	51	69
7	4	70	51
7	5	24	17
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7	8	139	133
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7	13	27	19
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7	19	37	38
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8	2	74	85
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8	5	132	129
8	6	118	128
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8	9	134	136
8	10	80	90
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8	19	33	26
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8	24	41	37
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9	4	65	65
9	7	112	113
9	8	29	35
9	9	41	36
9	11	121	119
9	17	39	37
9	23	57	58
9	27	69	61
10	1	119	117
10	2	45	51
10	3	103	105
10	4	77	83
10	5	83	88
10	6	129	132

Table 4. (Continued)

K	L	FO	FC
10	8	62	61
10	9	62	66
10	10	108	103
10	11	44	42
10	12	32	27
10	15	31	28
10	24	39	44
11	3	60	57
11	6	89	97
11	7	58	55
11	8	65	73
11	10	43	50
11	26	42	43
12	2	51	49
12	3	57	58
12	5	104	106
12	9	94	92
12	25	39	35
13	5	37	43
13	6	49	46
13	7	42	45
13	8	36	34
14	8	34	35
14	10	44	42
16	9	47	46
17	8	46	42
H= -1			
0	6	31	11
0	8	199	224
0	10	30	45
0	12	38	15
0	16	57	53
0	20	92	90
0	24	126	125
0	26	99	100
1	4	268	207
1	7	257	196
1	9	203	204
1	10	62	52
1	11	97	87
1	12	71	85
1	14	34	45
2	1	315	354
2	2	80	112
2	3	324	229
2	4	29	10
2	6	33	24
2	8	170	145
2	9	169	153
2	10	59	59
2	12	120	116
2	17	67	69
2	21	89	84
2	23	48	55
2	25	73	79
3	2	132	140
3	4	58	38
3	5	183	169
3	6	71	74
3	7	67	23
3	8	185	166
3	9	33	28
3	10	75	80
3	11	154	156
3	14	76	72
3	18	28	36
4	1	33	57
4	3	70	109
4	4	282	272
4	5	26	25
4	6	76	97
4	7	116	115
4	8	52	45
4	9	66	59
4	10	27	4
4	11	43	46
4	12	73	67
4	20	62	77
4	24	46	59
5	1	29	28
5	2	49	50
5	3	52	85
5	4	50	26
5	5	66	44
5	7	59	57
5	8	58	50
5	9	27	22
5	10	122	118
5	11	52	59
5	12	81	90
5	14	44	53
5	20	51	48
5	23	64	67
6	1	52	83
6	2	149	138
6	3	101	95
6	5	95	94
6	6	79	78
6	7	69	69
6	8	22	24
6	10	47	45
6	14	29	28
6	15	41	39
6	19	44	49
6	20	50	55
7	2	107	98
7	3	56	53
7	4	99	90
7	5	30	31
7	6	69	83
7	8	38	42
7	11	51	48
7	11	24	27
7	18	37	37
7	19	63	60
7	22	81	82
7	24	40	46
8	1	68	69
8	2	77	77
8	3	86	75
8	4	156	163
8	5	135	138
8	6	45	46
8	8	58	66
8	9	77	76
8	11	55	52
8	14	41	39
8	19	34	32
8	21	75	76
8	24	40	49
8	25	58	64
9	1	99	95
9	3	162	172
9	4	61	77
9	7	145	147
9	10	29	30
9	11	50	47
9	12	50	46
9	13	38	41
9	19	60	66
9	21	36	32
9	23	95	98
10	1	33	39
10	2	30	22
10	4	82	88
10	5	94	99
10	6	63	60
10	7	28	22
10	8	93	96
10	12	49	48
10	15	46	50
10	20	65	63
10	21	38	40
10	24	48	55
11	2	153	152
11	3	29	22
11	4	56	58
11	6	85	78
11	8	56	64
11	22	56	58
12	1	40	44
12	3	33	42
12	5	97	91
12	18	35	34
12	25	42	35
13	1	42	44
13	2	56	56
13	3	46	46
13	4	38	39
13	7	35	40
13	9	36	33
13	23	36	30
14	4	38	40
14	6	42	42
14	7	36	34
15	2	33	32
15	3	38	42
16	1	37	40
16	5	47	41
H= 0			
0	4	157	210
0	6	61	22
0	8	328	275
0	10	85	79
0	12	160	151
0	16	88	86
0	18	25	18
0	20	99	97
0	24	46	43
1	4	74	23
1	6	246	255
1	7	56	66
1	8	148	127
1	10	69	83
1	11	71	65
1	14	57	92
1	16	63	101
1	18	68	87
1	19	48	53
1	21	34	43
1	24	58	71
2	0	67	23
2	3	75	25
2	4	65	59
2	5	260	279
2	6	205	221
2	7	65	74
2	8	91	85
2	10	66	93
2	13	119	116
2	15	36	42
2	17	58	49
2	19	128	130
2	21	42	42
3	1	38	53
3	3	39	36
3	4	342	287
3	5	89	68
3	6	109	73
3	7	45	33
3	8	92	72
3	9	49	23
3	10	84	91
3	11	64	71
3	12	57	57
3	13	44	55
3	18	95	100
3	22	63	62
4	0	137	75
4	1	56	54
4	2	42	8
4	4	106	76
4	6	65	78
4	8	137	144
4	9	44	34
4	10	66	67
4	11	89	88
4	13	27	32
4	14	27	26
4	16	35	28
4	18	30	35
4	20	140	139
5	1	85	83
5	3	113	145
5	4	147	140
5	5	140	170
5	6	45	31
5	7	97	115
5	8	87	89
5	9	27	33
5	13	31	21
5	14	28	24
5	16	30	35
5	17	59	61
5	19	85	87
5	21	58	55
5	23	42	45
6	0	50	47
6	1	23	38
6	3	27	35
6	4	21	34
6	5	22	13
6	7	39	44
6	8	23	31
6	9	105	104
6	10	31	29
6	14	34	35
6	15	28	34
6	16	58	50
6	19	62	68
6	20	50	59
6	21	86	83
6	25	43	44
7	2	248	243
7	3	35	47
7	4	142	160
7	5	68	67
7	6	57	43
7	10	44	46
7	16	44	44
7	17	30	25
7	18	78	83
7	22	113	111
7	24	46	46
8	0	161	170
8	1	85	91
8	2	37	27
8	3	30	28
8	4	56	59
8	5	57	41
8	6	48	52
8	7	41	36
8	14	28	19
8	15	73	68
8	16	42	44
8	17	55	55
8	19	64	71
8	20	163	186
8	21	96	95
8	25	36	34
9	1	117	122
9	3	155	164
9	13	29	24
9	17	61	66
9	18	33	31
9	19	78	77
9	21	106	102
9	23	67	69
10	0	110	113
10	1	67	76
10	2	38	45
10	3	30	30
10	4	53	54
10	5	36	41
10	8	30	18
10	10	64	65
10	16	66	67
10	19	34	33
10	20	93	89
10	21	39	39
11	1	44	48
11	2	106	99
11	4	74	70
11	5	33	34
11	12	31	31
11	18	51	48
11	22	58	50
12	1	101	107
12	5	40	39
12	7	30	31
12	19	37	38
12	21	45	44
13	1	49	50
13	2	40	38
13	3	52	46
14	0	61	69
14	4	31	34
14	20	41	38
15	2	46	41
15	5	34	36
16	1	47	44
H= 1			
0	6	156	137
0	8	117	96
0	10	90	91
0	12	99	85
0	14	90	92
0	16	167	159
0	18	88	80
0	20	34	46
0	22	44	34
0	24	84	79
0	26	76	75
0	28	38	30
1	2	36	15
1	3	37	84
1	5	76	46
1	7	41	70
1	8	49	55
1	9	88	68
1	10	76	111
1	12	191	178
1	13	142	155
1	14	130	139
1	15	59	46
1	17	92	93
1	18	55	54
1	19	31	24
1	27	34	34
2	0	29	30
2	1	52	102
2	4	46	6
2	5	140	146
2	6	105	86
2	7	111	77
2	8	84	105
2	9	24	8
2	11	43	24
2	15	222	226
2	17	74	88
2	19	98	96
2	21	31	25
2	23	55	55
2	25	57	48
3	2	220	227
3	3	364	329
3	4	149	99
3	5	93	69
3	6	32	8
3	7	26	8
3	8	108	121
3	9	130	104
3	10	42	25
3	11	72	75
3	12	66	69
3	13	148	142
3	14	138	125
3	16	41	42
3	17	42	55
3	18	116	111
3	21	48	33
3	25	43	41
4	0	310	258
4	1	57	64
4	2	161	152
4	3	198	158
4	4	206	170
4	5	23	39
4	6	170	165
4	7	113	106
4	8	39	36
4	9	28	23
4	10	37	49
4	11	25	27
4	12	41	34
4	13	48	35
4	14	87	94
4	15	51	59
4	16	164	168
4	17	54	56
4	28	55	55
5	0	32	38
5	2	114	102
5	3	51	49
5	4	28	9
5	7	194	188
5	8	88	73
5	9	96	110
5	10	47	60
5	11	86	81
5	12	61	50
5	13	83	81
5	14	33	22
5	17	97	101
5	19	75	77
6	0	21	7
6	1	69	90
6	3	33	29
6	4	73	51
6	5	98	123
6	6	75	70
6	7	88	81

Table 4. (Continued)

K	L	FO	FC
6	14	55	59
6	15	99	109
6	16	34	48
6	17	41	41
6	19	81	78
6	23	32	31
7	0	23	30
7	2	52	75
7	4	62	62
7	6	83	75
7	8	102	104
7	9	26	24
7	10	50	56
7	11	46	39
7	12	61	62
7	14	45	49
7	16	46	47
7	18	121	117
8	0	56	57
8	1	45	61
8	2	52	56
8	3	72	74
8	11	36	43
8	14	66	65
8	15	73	68
8	16	42	42
8	17	39	43
8	19	41	43
8	20	74	75
9	0	34	36
9	2	27	17
9	4	32	31
9	7	33	35
9	13	107	102
9	17	85	85
9	18	41	39
9	19	60	57
9	27	37	36
10	0	95	91
10	1	72	69
10	2	63	64
10	4	26	34
10	8	31	37
10	12	78	83
10	14	50	51
10	16	53	51
10	19	35	36
10	20	40	42
11	0	77	79
11	1	54	50
11	6	32	33
11	12	45	48
11	14	42	45
11	18	78	70
12	1	55	55
12	2	33	41

K	L	FO	FC
12	9	32	31
12	11	44	40
12	19	35	40
13	10	41	40
13	17	45	41
13	19	44	48
14	0	43	39
14	14	42	39
14	16	39	37
15	1	39	34
16	15	51	50

H= 2

K	L	FO	FC
0	2	170	178
0	4	38	26
0	6	281	268
0	8	60	48
0	10	312	311
0	12	186	170
0	14	174	144
0	16	132	133
0	20	79	73
0	22	28	33
0	30	47	49
1	0	145	152
1	1	125	108
1	2	53	55
1	3	74	83
1	5	204	144
1	6	203	181
1	7	24	22
1	8	96	94
1	9	110	113
1	10	121	116
1	11	123	98
1	12	162	160
1	13	164	193
1	14	73	67
1	17	63	64
1	18	28	26
1	20	30	35
1	25	38	40
1	33	41	39
2	0	35	32
2	1	221	220
2	2	24	5
2	3	91	37
2	4	36	19
2	5	27	32
2	6	183	172
2	7	45	58
2	8	93	102
2	9	99	115
2	10	43	35
2	11	255	256

K	L	FO	FC
2	12	33	23
2	13	33	43
2	14	48	48
2	15	249	235
2	17	34	34
2	18	75	71
2	20	44	44
2	21	63	63
2	22	35	37
2	24	49	48
2	29	62	63
2	31	55	55
3	0	194	141
3	1	280	263
3	3	144	123
3	4	119	137
3	5	54	74
3	6	51	79
3	7	117	110
3	9	165	150
3	10	71	64
3	12	151	159
3	13	135	143
3	14	168	170
3	15	48	46
3	16	42	53
3	18	41	49
3	20	54	58
3	21	35	42
3	24	36	40
3	25	37	38
3	32	61	60
4	1	97	47
4	1	76	77
4	2	176	186
4	3	58	75
4	4	21	12
4	5	21	49
4	6	37	46
4	7	100	74
4	8	34	37
4	9	51	51
4	10	173	157
4	11	59	55
4	12	93	103
4	14	64	72
4	15	40	34
4	16	119	119
4	19	37	31
4	20	28	21
4	23	38	45
4	30	54	56
5	1	73	54
5	1	82	85
5	4	154	171
5	5	86	76

K	L	FO	FC
5	6	94	62
5	9	36	34
5	11	129	127
5	12	86	77
5	13	139	145
5	15	55	47
5	17	46	49
5	22	31	34
5	29	46	47
6	0	41	57
6	1	68	61
6	2	126	128
6	3	96	87
6	4	66	54
6	5	42	36
6	7	125	135
6	9	153	160
6	10	92	94
6	11	109	125
6	14	67	61
6	15	51	61
6	16	45	44
6	21	40	40
6	22	40	39
6	25	36	34
6	31	40	42
7	0	25	42
7	1	72	81
7	5	83	99
7	6	45	50
7	8	75	82
7	9	34	34
7	12	137	146
7	14	103	102
7	15	51	43
7	22	38	37
7	25	33	38
7	28	40	38
8	1	28	9
8	7	56	57
8	8	52	57
8	10	47	54
8	11	89	96
8	12	41	52
8	13	41	45
8	14	44	40
8	15	62	58
8	20	42	46
9	3	46	44
9	7	58	64
9	8	38	39
9	9	69	70
9	11	49	48
9	13	130	129
9	15	40	43
9	23	44	44

K	L	FO	FC
10	1	37	50
10	5	35	38
10	9	30	36
10	10	89	88
10	11	48	49
10	14	44	45
10	19	32	33
11	2	81	80
11	4	71	74
11	12	52	54
11	14	53	51
11	18	40	41
12	0	43	43
12	4	33	37
12	11	68	68
12	15	55	46
13	3	45	43
13	9	43	37
13	10	36	33
13	13	53	54
13	14	34	35
14	7	33	28
14	10	62	57
14	12	39	37
15	14	42	39
16	11	46	44

H= 3

K	L	FO	FC
0	0	42	66
0	2	188	30
0	4	114	144
0	6	177	182
0	8	77	82
0	10	142	148
0	14	145	132
0	18	58	52
0	22	36	28
0	24	44	45
0	26	49	44
0	30	48	48
1	0	26	20
1	1	29	17
1	2	21	13
1	3	208	148
1	4	165	129
1	5	35	49
1	6	42	54
1	7	47	52
1	8	221	207
1	9	191	173
1	11	127	112
1	12	125	136
1	13	148	156
1	14	85	66
1	16	51	53

K	L	FC	FC
1	29	46	44
2	1	22	24
2	2	112	76
2	3	71	45
2	4	65	39
2	5	229	173
2	6	80	59
2	7	68	76
2	8	64	53
2	9	55	62
2	10	48	59
2	11	217	209
2	13	25	35
2	14	115	116
2	15	91	86
2	16	26	26
2	17	78	77
2	18	27	35
2	19	38	43
2	21	58	52
2	22	57	56
2	25	86	88
2	27	52	53
2	29	47	48
2	31	48	45
3	0	128	142
3	1	195	182
3	2	36	47
3	3	91	97
3	5	195	162
3	6	122	132
3	8	158	173
3	9	111	119
3	10	111	112
3	11	74	78
3	12	131	131
3	13	73	77
3	14	103	103
3	15	59	53
3	16	65	66
3	17	77	79
3	18	37	39
3	21	51	50
3	22	33	39
3	28	86	91
4	0	78	93
4	2	34	45
4	3	74	69
4	4	69	80
4	6	98	108
4	7	24	20
4	9	108	115
4	10	178	155
4	11	129	123
4	12	119	120
4	13	107	94

K	L	FO	FC
4	15	49	47
4	16	33	35
4	18	42	48
4	20	63	61
4	23	34	35
4	26	83	81
4	30	68	71
5	0	47	58
5	4	156	162
5	5	38	45
5	6	133	129
5	7	208	206
5	8	89	89
5	9	198	207
5	11	49	55
5	13	58	56
5	15	28	24
5	16	29	21
5	22	49	52
5	27	46	46
5	29	66	64
6	0	69	81
6	1	202	202
6	2	83	42
6	3	90	61
6	5	108	119
6	6	96	92
6	7	64	56
6	9	169	167
6	10	179	188
6	11	92	99
6	12	34	34
6	14	27	21
6	18	41	43
6	25	37	32
6	27	41	38
6	29	36	32
6	31	52	53
7	1	84	90
7	3	35	47
7	4	79	79
7	5	53	71
7	6	84	75
7	8	167	171
7	9	41	39
7	11	29	27
7	12	74	75
7	14	33	26
7	15	36	28
7	18	38	40
7	21	38	43
7	28	60	60

H= 4

K	L	FO	FC
8	0	24	23
8	2	53	68
8	4	35	38
8	5	44	41

K	L	FO	FC
8	6	46	53
8	7	50	58
8	8	58	49
8	9	71	75
8	10	109	112
8	11	106	97
8	12	31	25
8	19	57	53
9	3	24	24
9	4	42	39
9	5	30	34
9	7	79	76
9	9	81	73
9	10	30	33
9	22	33	31
9	27	48	46
10	0	38	41
10	1	32	32
10	2	29	27
10	3	31	27
10	5	47	41
10	6	55	54
10	7	29	26
10	10	87	83
10	11	57	59
10	16	31	28
11	2	39	36
11	4	57	60
11	7	43	48
11	8	61	61
11	10	34	35
11	13	44	47
12	0	78	74
12	1	58	56
12	7	72	77
12	9	51	46
12	10	31	36
12	11	61	57
13	7	63	61
13	8	64	67
13	9	70	70
13	12	35	35
14	6	56	53
14	10	80	79
15	6	38	42
15	7	39	38
15	8	39	39
15	9	45	44
16	5	36	48
16	11	37	31
17	8	46	37

K	L	FO	FC
0	0	385	235
0	2	134	42

Table 4. (Continued)

K	L	FO	FC
0	4	162	138
0	6	105	90
0	8	79	65
0	10	37	49
0	16	136	135
0	22	37	26
0	26	47	44
1	1	98	43
1	2	89	76
1	3	108	143
1	4	136	146
1	5	87	90
1	7	63	84
1	8	134	127
1	9	119	110
1	10	34	40
1	13	37	6
1	15	37	31
1	16	85	91
1	17	57	58
1	21	46	46
1	23	33	37
1	28	41	38
2	0	30	61
2	1	37	37
2	2	88	55
2	4	45	29
2	5	305	258
2	6	90	75
2	7	149	124
2	8	119	124
2	10	41	59
2	11	64	76
2	13	26	14
2	14	37	38
2	15	82	72
2	17	27	32
2	21	59	61
2	23	46	40
2	25	72	71
2	26	39	39
2	27	40	38
3	0	184	178
3	1	64	91
3	2	102	81
3	4	140	149
3	5	56	62
3	6	51	49
3	7	76	64
3	8	231	211
3	10	149	149
3	11	38	31
3	12	58	48
3	13	69	58
3	14	66	55
3	22	58	60
3	23	53	58
3	24	86	95
3	28	69	66
4	0	38	33
4	1	117	147
4	2	65	68
4	3	198	176
4	4	121	134
4	6	185	195
4	7	97	101
4	10	105	95
4	11	37	45
4	12	51	48
4	14	65	61
4	15	58	56
4	18	34	39
4	22	86	80
4	24	46	50
4	25	41	42
4	26	80	87
4	27	39	36
5	0	77	79
5	1	33	47
5	2	145	143
5	3	124	127
5	4	52	49
5	5	79	78
5	6	33	25
5	7	176	174
5	8	99	117
5	9	147	153
5	10	49	43
5	11	24	20
5	13	35	33
5	15	55	53
5	19	47	49
5	23	59	60
5	27	57	61
5	29	38	41
6	0	69	82
6	1	55	55
6	2	133	118
6	3	23	27
6	4	29	17
6	5	159	156
6	6	97	94
6	7	138	128
6	9	70	60
6	10	44	43
6	14	75	67
6	18	29	25
6	21	37	39
6	25	48	44
6	26	41	38
6	27	38	38
7	0	38	35
7	1	40	56
7	3	25	27
7	4	127	123
7	5	24	20
7	6	77	71
7	7	30	26
7	8	98	103
7	9	66	75
7	10	29	34
7	11	31	24
7	12	97	100
7	13	31	34
7	19	33	32
7	20	33	25
7	24	39	39
7	28	44	38
8	1	59	60
8	2	24	33
8	4	39	40
8	5	67	72
8	6	89	103
8	7	52	62
8	8	48	54
8	9	45	49
8	12	38	46
8	13	30	40
8	14	35	34
8	15	58	58
8	16	47	50
8	18	46	39
8	25	37	37
8	26	40	35
9	0	39	39
9	3	62	60
9	4	51	49
9	5	40	33
9	7	33	42
9	9	54	56
9	10	43	41
9	11	38	31
9	23	51	52
10	0	43	34
10	2	40	40
10	4	29	31
10	5	45	40
10	6	89	92
10	7	72	76
10	10	41	41
10	13	32	31
10	16	33	34
10	26	55	52
11	1	32	38
11	2	41	44
11	3	30	30
11	4	73	72
11	6	37	39
11	7	47	46
11	8	85	91
11	24	51	56
12	2	31	36
12	4	33	34
12	5	85	86
12	6	48	47
12	7	88	85
12	9	86	90
12	14	40	35
12	21	45	43
13	3	60	66
13	4	36	32
13	7	87	87
13	8	57	58
13	9	46	40
13	10	43	42
14	6	104	98
14	15	40	38
15	3	36	28
15	7	41	36
15	8	41	44
16	5	61	53
16	7	38	38
17	4	43	36

H= 5

K	L	FO	FC
0	0	257	248
0	2	84	113
0	6	76	55
0	8	24	56
0	10	112	79
0	12	39	33
0	14	60	62
0	16	41	53
0	20	73	79
0	22	96	99
0	26	71	69
1	0	29	39
1	1	55	49
1	2	43	42
1	3	29	15
1	4	56	18
1	9	43	37
1	10	40	18
1	11	82	82
1	12	31	36
1	13	79	66
1	14	61	51
1	16	56	48
1	17	39	42
1	18	74	74
1	19	88	86
1	20	41	40
1	23	57	61
1	24	60	66
1	25	52	47
2	0	28	33
2	1	270	257
2	3	77	44
2	4	29	30
2	5	211	181
2	6	41	23
2	8	94	85
2	9	72	79
2	10	93	69
2	11	32	14
2	12	35	41
2	14	46	37
2	15	34	29
2	16	32	30
2	17	31	25
2	18	35	29
2	20	49	44
2	21	121	120
2	25	46	46
3	0	180	182
3	1	29	44
3	2	160	144
3	3	39	31
3	4	151	152
3	5	171	156
3	6	36	10
3	7	24	19
3	8	63	56
3	9	37	57
3	12	32	33
3	13	43	49
3	14	30	31
3	15	41	43
3	17	71	66
3	18	69	73
3	19	32	33
3	20	45	40
3	22	86	83
3	23	34	33
3	24	64	73
4	0	212	210
4	1	73	82
4	2	169	181
4	4	43	48
4	5	36	35
4	6	170	182
4	7	26	28
4	8	59	59
4	9	27	16
4	10	89	88
4	11	60	62
4	12	64	68
4	13	52	47
4	17	57	50
4	19	37	35
4	20	93	93
4	21	71	67
4	22	77	74
4	24	44	41
5	1	26	35
5	2	28	16
5	3	221	221
5	4	98	95
5	5	121	115
5	6	95	97
5	7	34	37
5	11	70	64
5	13	49	48
5	15	30	35
5	19	82	79
5	23	70	76
6	0	157	141
6	1	208	202
6	2	151	152
6	3	78	71
6	5	123	123
6	6	46	49
6	7	76	71
6	9	109	106
6	10	46	54
6	11	84	89
6	13	26	29
6	16	54	57
6	18	58	57
6	21	40	35
6	22	45	43
6	26	40	38
7	0	103	125
7	2	146	158
7	3	60	59
7	4	214	213
7	7	28	24
7	10	44	53
7	12	93	90
7	14	52	54
7	15	28	27
7	17	51	47
7	18	35	42
7	24	43	42
8	0	59	55
8	1	126	124
8	2	89	94
8	3	101	104
8	7	32	24
8	8	53	44
8	9	51	60
8	10	72	82
8	11	66	66
8	12	42	42
8	13	28	21
8	16	41	37
8	19	40	41
8	21	42	39
8	22	38	35
9	0	26	24
9	3	121	127
9	4	29	25
9	5	59	59
9	6	83	80
9	8	28	24
9	10	30	36
9	11	44	42
9	12	54	64
9	13	82	82
9	15	58	59
9	19	37	36
9	23	42	45
10	0	85	79
10	1	73	76
10	2	70	67
10	3	59	57
10	6	58	57
10	11	36	34
10	12	51	55
10	13	37	37
10	20	54	54
10	22	35	37
11	0	51	48
11	2	91	82
11	3	29	21
11	4	80	81
11	7	47	45
11	10	34	39
11	11	57	54
11	12	54	49
11	19	35	38
11	23	41	37
12	0	52	55
12	1	85	97
12	5	93	93
12	8	34	35
12	10	65	61
12	21	70	68
13	0	40	41
13	3	67	61
13	4	56	56
13	5	49	53
13	13	33	36
13	19	43	45
13	20	38	29
14	6	83	84
15	3	36	30
15	4	43	44
16	1	47	47

H= 6

K	L	FO	FC
0	0	158	161
0	2	24	11
0	4	29	34
0	6	52	64
0	12	78	84
0	16	143	141
0	18	42	46
0	20	119	112
0	22	63	68
1	1	32	20
1	3	43	29
1	4	37	45
1	7	22	33
1	8	39	32
1	10	26	32
1	11	68	61
1	12	30	35
1	14	89	84
1	15	102	118
1	17	45	45
1	18	83	86
1	19	92	98
1	20	48	51
1	21	31	33
2	1	185	186
2	2	47	43
2	3	71	51
2	4	59	41
2	5	71	71
2	7	112	115
2	8	46	53
2	9	35	44
2	10	30	26
2	12	58	67
2	14	73	69
2	15	96	97
2	16	43	44
2	17	83	88
2	18	42	45
2	19	45	42
2	21	119	117
3	0	22	28
3	1	36	38
3	2	98	84
3	5	28	46
3	6	53	57
3	8	58	48
3	10	47	33
3	11	58	45
3	13	62	68
3	14	114	108
3	17	58	68
3	18	104	104
3	19	54	51

Table 4. (Continued)

K	L	FO	FC
3	20	79	86
3	24	35	30
4	0	179	202
4	1	41	44
4	2	83	88
4	3	34	37
4	6	67	77
4	7	50	37
4	13	53	58
4	15	53	55
4	16	78	88
4	17	57	58
4	18	36	40
4	20	110	137
4	22	44	44
5	1	36	34
5	3	108	112
5	4	57	65
5	5	28	19
5	6	31	22
5	7	76	58
5	8	52	55
5	9	91	85
5	10	56	49
5	13	36	31
5	14	37	37
5	15	61	64
5	17	61	61
5	18	32	37
5	19	78	72
5	21	47	45
5	23	36	36
6	0	117	99
6	1	221	218
6	2	132	125
6	3	43	42
6	5	68	62
6	6	39	40
6	7	54	51
6	8	75	78
6	9	65	55
6	10	28	33
6	12	51	46
6	13	30	27
6	14	34	38
6	15	35	30
6	16	44	45
6	17	53	50
6	21	32	33
7	0	165	170
7	1	39	35
7	2	80	72
7	4	50	47
7	6	29	23
7	7	37	33
7	8	52	55
7	10	37	40
7	11	43	38
7	13	37	41
7	14	43	41
7	15	36	34
7	16	73	79
8	0	79	83
8	1	110	119
8	2	73	81
8	5	69	69
8	12	51	54
8	14	48	52
8	16	73	79
8	17	55	58
8	18	55	58
9	1	34	31
9	2	51	47
9	3	65	66
9	17	50	57
9	19	77	81
10	0	81	90
10	1	38	29
10	2	54	53
10	4	42	43
10	9	38	32
10	13	39	45
10	15	36	43
10	16	55	53
10	22	35	37
11	0	63	61
11	3	48	53
11	8	58	57
11	15	34	40
11	16	34	36
11	18	71	73
11	20	41	42
12	7	37	41
12	15	40	40
12	17	48	44
12	21	46	44
13	7	40	40
13	9	44	42
13	17	47	52
13	19	59	61
14	2	36	28
14	16	57	56
15	10	37	36
16	1	34	35

H= 7

K	L	FO	FC
0	18	71	64
1	0	74	71
1	1	34	26
1	2	75	67
1	7	39	42
1	8	55	59
1	10	34	38
1	11	34	38
1	13	104	96
1	14	108	110
1	15	89	82
1	17	40	43
2	0	28	32
2	3	61	67
2	4	74	68
2	5	23	25
2	6	43	33
2	8	47	51
2	9	33	28
2	10	64	73
2	11	112	114
2	13	66	68
2	15	105	106
2	17	119	118
3	0	48	34
3	1	27	46
3	2	23	18
3	3	74	76
3	8	79	76
3	10	50	46
3	12	68	65
3	13	104	107
3	14	160	166
3	15	41	46
3	16	34	35
3	18	42	42
3	19	30	35
4	0	82	94
4	1	47	54
4	3	97	98
4	4	63	58
4	5	61	66
4	6	43	56
4	7	27	36
4	10	161	170
4	12	152	161
4	13	47	47
4	14	41	40
4	16	144	145
4	18	63	67
5	1	53	48
5	2	43	32
5	5	57	40
5	6	29	22
5	9	93	100
5	11	45	40
5	13	161	163
5	14	29	34
5	15	110	109
5	17	52	54
5	19	38	38
6	0	37	36
6	1	79	79
6	3	75	71
6	5	87	77
6	7	51	59
6	11	117	122
6	12	91	99
6	13	70	74
6	15	81	87
6	16	49	47
6	17	80	81
6	18	39	38
7	1	46	47
7	2	28	37
7	3	59	68
7	4	66	70
7	7	30	36
7	10	69	69
7	12	43	35
7	14	150	148
7	16	36	25
7	18	43	46
7	21	48	50
8	0	38	45
8	6	27	28
8	8	40	38
8	12	41	44
8	13	39	40
8	15	60	58
8	16	61	58
8	18	41	42
9	1	31	28
9	9	29	34
9	11	35	33
9	13	88	86
9	15	92	91
9	19	34	28
9	23	35	36
10	1	37	39
10	7	50	45
10	12	47	41
10	15	45	43
10	18	51	56
10	17	41	46
10	18	41	41
11	2	29	27
11	7	32	30
11	8	44	46
11	12	43	43
11	14	71	67
11	16	35	35

K	L	FO	FC
11	18	41	36
12	1	45	46
12	11	40	42
12	13	43	49
12	15	35	26
12	17	52	52
13	13	51	54
13	15	46	48
14	12	45	47
14	16	47	47
15	14	43	40

H= 8

K	L	FO	FC
0	0	88	75
0	2	47	39
0	4	44	44
0	6	102	123
0	8	43	54
0	10	83	86
0	12	140	141
0	14	70	69
0	16	30	25
0	20	70	65
0	22	58	57
0	28	50	52
1	3	28	24
1	5	24	19
1	6	37	30
1	7	29	34
1	8	64	69
1	9	67	67
1	10	59	51
1	11	27	14
1	12	66	61
1	13	103	111
1	14	97	95
1	15	66	56
1	19	50	55
1	29	49	47
2	0	121	108
2	2	32	31
2	3	69	70
2	4	70	66
2	5	36	23
2	7	88	94
2	11	172	180
2	12	39	39
2	13	98	103
2	20	53	54
2	21	56	58
2	23	35	31
2	27	48	49
3	2	41	45
3	4	35	35
3	6	30	22
3	8	93	89
3	9	54	59
3	10	114	114
3	12	59	57
3	13	132	135
3	14	119	121
3	16	47	45
3	19	37	36
3	30	41	41
4	0	29	18
4	1	23	29
4	2	43	41
4	3	74	84
4	4	47	38
4	5	92	81
4	6	68	60
4	8	92	88
4	9	29	39
4	10	104	104
4	11	95	99
4	12	138	134
4	13	43	42
4	16	68	62
4	19	38	27
4	22	32	29
4	26	45	41
5	3	68	70
5	4	33	37
5	5	35	32
5	7	55	58
5	9	175	177
5	11	29	36
5	12	32	32
5	13	108	116
5	15	63	64
5	29	41	46
6	0	74	72
6	1	92	84
6	2	66	59
6	3	49	54
6	7	86	83
6	8	68	62
6	10	57	57
6	11	111	121
6	12	79	74
6	14	47	47
6	15	63	65
6	16	46	45
6	17	41	41
7	0	57	55
7	8	66	72
7	10	123	127
7	12	35	39
7	14	112	116
7	17	35	30
8	1	55	57
8	2	62	64
8	10	52	50
8	11	95	95
8	12	77	73
8	13	47	53
8	15	59	56
8	16	35	43
9	1	63	68
9	3	53	52
9	5	34	39
9	8	50	49
9	9	91	94
9	13	67	64
9	15	64	71
9	17	34	32
10	0	44	43
10	1	29	22
10	2	36	38
10	3	34	32
10	4	29	38
10	10	56	60
10	11	36	31
10	12	55	56
11	4	35	28
11	6	34	37
11	10	33	26
11	14	49	44
11	16	47	46
12	11	46	41
13	9	36	34
14	12	48	48

H= 9

K	L	FO	FC
0	0	73	67
0	4	35	32
0	10	59	60
0	12	65	62
0	16	53	50
0	22	50	49
0	26	87	89
0	28	56	56
1	1	26	32
1	2	59	59
1	3	28	29
1	5	37	44
1	6	34	36
1	8	29	28
1	9	80	84
1	10	66	67
1	11	26	30
1	13	30	29
1	14	75	80
1	15	34	32
1	17	64	63
1	18	33	36
1	20	35	36
1	25	46	53
1	29	39	40
2	0	54	58
2	1	55	53
2	7	114	114
2	11	87	89
2	13	27	21
2	17	47	45
2	18	30	27
2	25	37	31
2	27	74	72
3	1	46	53
3	4	57	47
3	5	55	61
3	6	27	27
3	8	132	125
3	9	124	123
3	10	113	116
3	11	51	47
3	12	34	34
3	18	49	53
3	21	32	31
3	24	42	42
4	4	54	55
4	5	39	31
4	6	147	149
4	7	107	113
4	8	99	109
4	10	97	108
4	11	57	49
4	12	61	59
4	15	45	45
4	19	39	35
4	26	53	53
4	28	36	35
5	0	40	41
5	2	25	18
5	3	58	66
5	4	43	41
5	5	110	111
5	7	89	90
5	9	160	161
5	10	61	49
5	13	33	36
5	25	56	52
6	3	49	54
6	4	69	72
6	5	63	65
6	6	89	92
6	7	118	128
6	8	70	69
6	10	68	68
6	11	43	43
6	12	34	38
6	15	32	33

Table 4. (Continued)

K	L	FO	FC
6	25	50	46
6	27	44	48
7	4	65	67
7	8	80	82
7	9	28	27
7	10	64	68
7	12	45	53
7	14	36	40
7	24	63	61
8	5	43	42
8	6	84	77
8	7	106	98
8	8	51	48
8	11	80	75
8	13	32	33
9	0	44	52
9	2	67	59
9	4	32	23
9	5	78	82
9	6	34	34
9	7	35	34
9	9	61	61
9	12	34	31
10	1	30	36
10	3	44	44
10	4	36	40
10	5	45	44
10	6	72	75
10	7	33	39
10	8	35	36
11	0	38	39
11	1	63	70
11	4	41	43
21	5	55	58
11	8	38	45
12	4	43	47
12	7	44	41
12	11	38	37
13	5	37	35
14	6	58	58
14	8	43	41

H= 10

K	L	FO	FC
0	0	67	67
0	2	114	112
0	6	77	72
0	16	31	30
0	22	72	72
0	26	63	59
1	0	45	36
1	1	62	69
1	2	25	18
1	3	50	47
1	4	30	30
1	5	41	43
1	13	79	75
1	14	85	81
1	15	58	55
1	16	46	51
1	18	39	38
1	19	54	54
1	23	53	53
1	24	63	64
1	25	51	51
2	0	41	35
2	1	97	96
2	2	25	24
2	3	85	86
2	5	74	74
2	7	63	66
2	13	42	40
2	18	34	36
2	21	45	47
2	23	53	51
2	25	51	51
2	27	44	48
3	0	99	100
3	1	40	39
3	3	25	26
3	4	130	146
3	5	59	67
3	6	50	50
3	8	49	52
3	10	38	41
3	13	33	31
3	14	83	82
3	15	45	44
3	17	38	34
3	24	90	88
4	1	31	25
4	2	113	111
4	3	73	76
4	4	49	50
4	5	29	26
4	6	131	139
4	7	71	68
4	8	69	72
4	12	32	32
4	13	59	59
4	19	35	33
4	22	59	59
4	23	34	34
4	26	45	50
5	0	41	48
5	1	75	78
5	3	95	96
5	4	36	38
5	5	151	152
5	6	58	53
5	7	36	33
5	9	93	96
5	11	29	34
5	23	50	50
5	25	64	64
6	0	40	36
6	1	72	77
6	2	69	72
6	3	114	120
6	6	65	61
6	7	81	93
6	10	65	66
6	21	45	44
6	22	39	39
6	23	58	54
7	2	46	50
7	4	134	134
7	5	35	38
7	6	42	49
7	7	45	44
7	8	60	58
7	12	41	33
7	20	46	41
7	24	70	71
8	0	45	45
8	1	42	34
8	2	67	59
8	3	56	57
8	5	29	32
8	6	55	58
8	7	58	58
8	15	39	34
8	22	52	52
8	23	42	39
9	0	34	24
9	2	57	53
9	3	91	96
9	5	78	75
9	7	41	39
9	13	38	36
9	19	43	40
10	1	47	55
10	2	78	85
10	3	32	33
10	6	52	58
11	0	35	39
11	1	44	46
11	4	67	69
11	8	34	37
12	1	48	45
12	3	72	75
12	7	55	53
13	0	43	41
13	3	37	36
13	4	51	52
13	5	45	45
14	2	58	60
14	6	39	37
15	4	44	44

H= 11

K	L	FO	FC
0	0	68	68
0	2	144	150
0	6	28	16
0	10	32	30
0	12	49	51
0	16	39	36
0	22	53	53
1	0	92	97
1	1	79	79
1	3	54	54
1	9	42	37
1	12	32	31
1	17	49	43
1	18	39	37
1	19	55	56
1	20	62	63
1	23	43	40
2	1	167	171
2	3	111	119
2	13	41	35
2	16	36	36
2	20	45	48
2	21	83	79
2	23	44	44
3	0	167	172
3	4	100	99
3	5	28	27
3	6	30	31
3	9	28	26
3	10	44	45
3	11	35	27
3	13	36	32
3	16	58	60
3	18	70	70
3	20	65	66
3	21	44	44
3	24	38	38
4	0	36	42
4	1	31	36
4	2	161	160
4	3	45	49
4	4	58	60
4	6	34	32
4	10	31	25
4	12	34	35
4	14	40	44
4	17	51	51
4	18	45	47
4	22	82	80
5	1	89	94
5	3	56	55
5	5	49	40
5	9	48	46
5	10	33	29
5	15	44	40
5	19	57	60
5	21	61	56
5	23	40	35
6	1	109	106
6	2	45	52
6	3	67	69
6	8	30	28
6	10	51	49
6	13	43	40
6	14	33	30
6	21	69	65
6	22	65	63
6	23	52	51
7	0	121	130
7	4	53	50
7	7	41	42
7	9	41	39
7	18	37	32
7	20	89	85
7	24	40	41
8	1	36	39
8	2	73	75
8	3	51	54
8	4	40	44
8	9	35	30
8	16	35	39
8	17	56	54
8	18	42	41
8	21	48	48
8	22	49	50
9	1	61	57
9	3	51	47
9	5	53	54
9	19	65	65
10	2	50	53
10	3	35	37
10	6	34	34
10	15	34	33
10	16	38	36
10	18	38	40
11	0	77	74
11	3	35	34
11	4	46	43
12	1	56	56
13	1	45	41
14	2	66	62
15	0	45	47

H= 12

K	L	FO	FC
0	0	52	46
0	2	34	37
0	6	40	43
0	8	110	98
0	10	61	60
0	12	81	91
0	16	47	50
0	18	110	96
1	0	87	91
1	3	42	34
1	5	30	25
1	8	29	24
1	9	47	46
1	10	34	42
1	12	31	30
1	13	35	35
1	14	69	65
1	15	80	78
1	17	34	34
2	1	79	84
2	2	42	47
2	12	38	39
2	13	82	79
2	14	65	60
2	15	35	40
2	17	61	64
3	0	89	79
3	6	48	47
3	10	30	27
3	12	55	58
3	14	71	67
3	16	46	44
4	2	41	37
4	6	98	95
4	8	84	82
4	12	30	26
4	13	76	71
4	14	53	56
5	1	34	29
5	3	30	29
5	5	50	49
5	10	31	29
5	11	65	63
5	12	44	40
5	13	40	37
5	15	45	48
5	19	48	47
6	1	32	32
6	5	64	67
6	6	37	36
6	7	53	55
6	9	31	28
6	13	33	43
6	14	37	36
6	17	44	46
6	18	46	45
6	19	35	32
7	0	89	87
7	2	31	24
7	3	48	45
7	4	42	38
7	7	52	56
7	14	40	42
7	16	72	73
7	20	70	72
8	1	38	40
8	4	40	44
8	6	43	44
8	13	47	45
8	17	48	52
8	18	52	55
9	1	64	67
9	2	43	46
9	15	80	86
9	19	63	59
10	14	34	28
10	16	44	46
11	0	51	48
11	14	52	52

H= 13

K	L	FO	FC
0	2	39	37
0	4	35	37
0	6	37	38
0	12	151	150
0	14	67	72
0	16	59	59
0	18	38	35
0	20	40	37
1	3	41	44
1	11	98	93
1	14	79	78
1	15	61	62
1	16	44	38
2	3	101	96
2	4	39	41
2	6	36	37
2	7	32	30
2	11	107	112
2	13	115	122
2	17	45	42
3	4	94	84
3	5	48	54
3	9	36	35
3	16	105	107
3	12	35	35
3	13	58	57
3	14	65	67
4	1	33	33
4	2	69	70
4	4	31	30
4	8	42	36
4	12	76	74
5	3	49	50
5	4	34	35
5	7	39	39
5	10	33	38
5	11	39	39
5	15	41	35
6	1	33	32
6	3	39	42
6	5	31	37
7	4	44	50
7	10	34	32
7	14	49	48
7	16	49	43
8	12	44	42
8	13	44	39
8	14	51	45
9	11	46	47
9	15	76	79
10	11	35	31
10	12	69	66
10	13	39	38
10	16	40	38
11	10	52	52
11	14	48	48
12	11	41	42
12	13	41	42

H= 14

K	L	FO	FC
0	0	36	36
0	2	53	53
0	4	41	40
0	6	31	36
0	8	130	132
0	12	140	145
0	14	35	35
0	16	39	39
1	0	56	55
1	1	66	63
1	5	45	46
1	6	31	40
1	9	143	141
1	10	133	128
1	11	112	113
1	13	59	55
1	14	36	35
1	15	45	48
1	16	33	33
2	1	39	39
2	3	31	34
2	7	129	130
2	8	49	49
2	9	100	101
2	11	81	83
2	13	58	62
3	0	57	57
3	1	46	50

Table 4. (Continued)

K	L	FO	FC	K	L	FO	FC	K	L	FO	FC	K	L	FO	FC
3	3	38	37	3	7	37	40	5	1	67	66	2	9	52	49
3	4	49	49	3	9	44	40	5	5	38	36	3	6	54	51
3	8	49	50	3	10	47	45	6	2	35	36	4	4	48	43
3	10	116	116	3	16	42	37	6	3	43	40				
3	11	35	34	4	0	49	48	7	0	57	59				
3	14	39	40	4	3	40	41	7	4	49	48				
4	1	49	47	4	7	50	50	8	2	49	49				
4	4	37	40	4	8	55	58	8	3	57	57				
4	6	80	76	4	9	48	45	8	4	45	41				
4	9	57	60	5	3	35	35	9	1	72	69				
4	12	49	53	5	5	56	53	9	5	66	68				
5	2	44	43	5	9	41	37	10	2	43	42				
5	9	40	40	6	2	51	52	10	4	43	43				
5	11	32	32	6	3	62	62	11	6	39	36				
6	7	71	72	6	4	36	40								
6	11	37	36	6	7	55	55		H=	17					
7	6	34	33	6	8	44	46								
7	9	43	47	7	2	38	42	0	2	69	69				
7	10	63	62	7	4	59	65	0	4	45	40				
8	7	41	39	7	6	71	71	0	18	62	61				
8	8	71	71	7	10	35	32	2	3	39	38				
8	11	56	52	8	3	37	43	2	6	35	37				
8	12	45	40	8	6	64	64	2	17	38	39				
8	13	42	40	8	7	46	45	3	0	52	54				
9	9	69	64	8	8	58	61	5	1	51	54				
9	11	69	68	9	5	77	74	7	0	86	87				
10	6	41	39	9	9	37	38	8	3	42	42				
10	8	55	55	10	4	38	34	9	1	63	61				
10	12	53	53	10	8	48	47								
11	15	57	57	10	9	39	35		H=	18					
	H=	15			H=	16		0	0	36	34				
								0	4	36	36				
0	0	86	89	0	0	34	33	0	8	34	34				
0	4	109	108	0	2	89	88	0	12	39	35				
0	6	121	117	0	4	35	43	0	14	49	44				
0	8	184	182	0	6	44	49	1	15	41	35				
0	22	42	39	0	12	33	45	1	16	37	32				
1	1	62	60	1	1	49	51	2	13	47	42				
1	4	73	74	1	4	44	50	3	3	36	31				
1	5	125	123	1	5	58	59	4	14	39	40				
1	6	84	80	1	6	50	53								
1	7	71	72	1	20	39	38		H=	19					
1	9	64	67	1	21	49	45								
1	10	61	71	2	3	67	65	0	10	36	33				
2	2	40	35	2	7	56	53	1	11	36	30				
2	3	75	74	2	13	43	41	2	9	39	39				
2	4	35	35	2	19	38	39	2	13	43	43				
2	7	99	99	3	0	62	68	3	10	37	36				
2	8	33	34	3	1	42	43	4	8	37	38				
2	9	77	77	3	6	80	76	5	7	36	39				
3	1	56	58	3	20	47	44								
3	3	49	47	4	1	48	51		H=	20					
3	4	51	53	4	2	56	56								
3	5	46	51	4	4	58	55	0	8	46	45				
3	6	68	71	4	8	50	49	2	7	36	34				

CHAPTER III

RESULTS AND DISCUSSION

The structure of $[Co_3(Dma)_6](ClO_4)_2$ is shown in Figures 4 and 5 (see Figure 6 for the system of numbering). Bond distances and bond angles are given in Tables 5 and 6, respectively. The structure consists of linear trinuclear cations and discrete perchlorate anions. Each of the terminal cobalt atoms is octahedrally coordinated by three chelate ligands through the oxime and imine nitrogen atoms. The central cobalt is octahedrally coordinated by the six oxime oxygens.

In order to balance charges, it is necessary for two ot the cobalt ions to be trivalent and one to be divalent. Charge assignments at the terminal and central cobalts can be made on the basis of bond distances. Co-N distances for the terminal cobalt atoms are between 1.89 - 2.00 Å and Co-O distances for the central cobalt are between 2.10 - 2.12 Å. Reported Co(II)-N distances lie between 2.11 - 2.241 Å[11,37] and Co(III)-N distances between 1.88 - 2.02 Å.[11,12,37] Co(II)-O distances of 1.99 - 2.225 Å have been observed[8,9,10] and Co(III)-O distances of 1.83 - 1.98 Å.[10,11,12] Comparison of Co-N distances indicates that the terminal cobalt ions can be assigned as cobalt(III) and comparison of Co-O

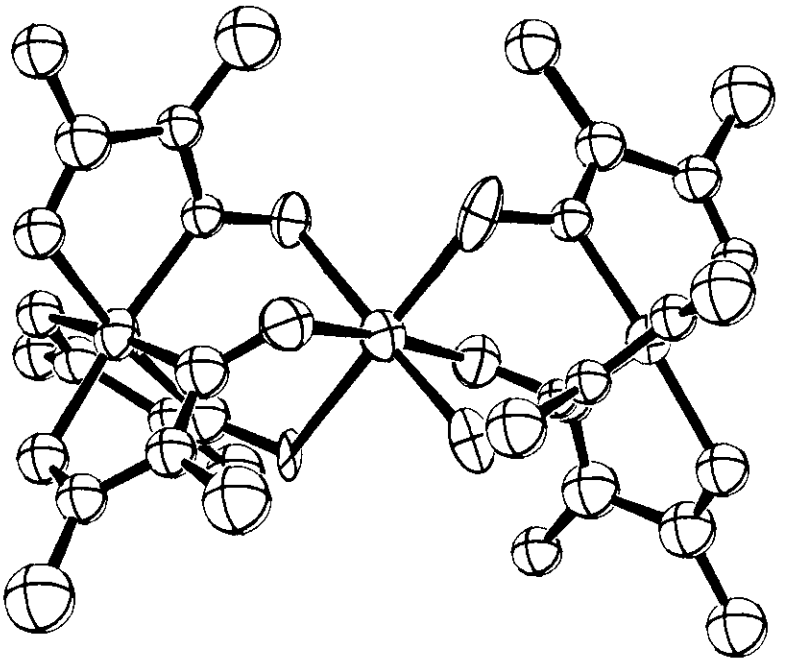

Figure 4. A Perspective Drawing of the Structure of $[Co_3(Dma)_6](ClO_4)_2$ (Phenyl Rings and Perchlorates omitted)

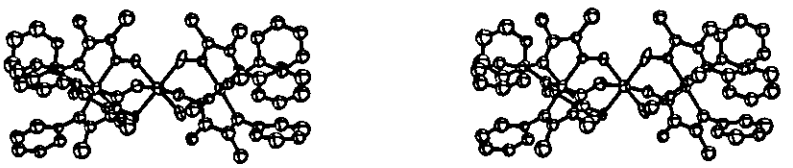

Figure 5. A Stereo View of $[Co_3(Dma)_6](ClO_4)_2$
(Perchlorates omitted)

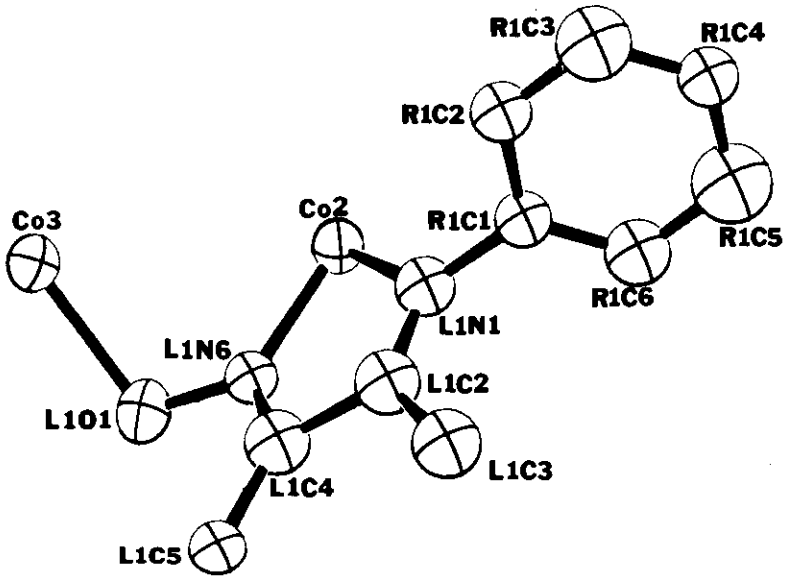

Figure 6. System of Numbering Used for $[Co_3(Dma)_6](ClO_4)_2$

Table 5. Interatomic Distances for $[Co_3(Dma)_6](ClO_4)_2$

Atoms	Distances (Å)	Atoms	Distances (Å)
Co1-Co3	3.453(4)	L2N1-L2C2	1.31(2)
Co2-Co3	3.455(4)	L2C2-L2C3	1.52(2)
Co1-L4N1	1.96(1)	L2C2-L2C4	1.45(2)
Co1-L4N6	1.89(1)	L2C4-L2C5	1.52(2)
Co1-L5N1	1.98(1)	L2C4-L2N6	1.29(2)
Co1-L5N6	1.89(1)	L2N6-L2O1	1.32(1)
Co1-L6N1	1.97(1)	L3N1-L3C2	1.28(2)
Co1-L6N6	1.89(1)	L3C2-L3C3	1.51(3)
Co2-L1N1	2.00(1)	L3C2-L3C4	1.46(2)
Co2-L1N6	1.91(1)	L3C4-L3C5	1.55(2)
Co2-L2N1	1.97(1)	L3C4-L3N6	1.28(2)
Co2-L2N6	1.90(1)	L3N6-L3O1	1.31(1)
Co2-L3N1	1.97(1)	L4N1-L4C2	1.33(2)
Co2-L3N6	1.91(1)	L4C2-L4C3	1.53(2)
Co3-L1O1	2.12(1)	L4C2-L4C4	1.42(2)
Co3-L2O1	2.117(9)	L4C4-L4C5	1.52(2)
Co3-L3O1	2.12(1)	L4C4-L4N6	1.32(2)
Co3-L4O1	2.12(1)	L4N6-L4O1	1.31(1)
Co3-L5O1	2.10(1)	L5N1-L5C2	1.28(2)
Co3-L6O1	2.109(9)	L5C2-L5C3	1.54(3)
L1N1-L1C2	1.28(2)	L5C2-L5C4	1.45(2)
L1C2-L1C3	1.50(3)	L5C4-L5C5	1.53(2)
L1C2-L1C4	1.48(2)	L5C4-L5N6	1.31(2)
L1C4-L1C5	1.48(3)	L5N6-L5O1	1.32(1)
L1C4-L1N6	1.32(2)	L6N1-L6C2	1.27(2)
L1N6-L1O1	1.31(1)	L6C2-L6C3	1.54(3)
L6C2-L6C4	1.44(2)		
L6C4-L6C5	1.50(2)		
L6C4-L6N6	1.32(2)		
L6N6-L6O1	1.32(1)		

Table 6. Interatomic Angles for $[Co_3(Dma)_6](ClO_4)_2$

Atoms	Degrees	Atoms	Degrees
L4N1-Co1-L4N6	81.6(5)	L2N1-Co2-L3N6	171.3(5)
L4N1-Co1-L5N1	97.1(5)	L2N6-Co2-L3N1	91.5(5)
L4N1-Co1-L5N6	171.2(5)	L2N6-Co2-L3N6	90.3(5)
L4N1-Co1-L6N1	95.9(5)	L3N1-Co2-L3N6	81.0(5)
L4N1-Co1-L6N6	92.3(5)	L1O1-Co3-L2O1	89.6(4)
L4N6-Co1-L5N1	92.2(5)	L1O1-Co3-L3O1	89.4(4)
L4N6-Co1-L5N6	89.8(5)	L1O1-Co3-L4O1	175.7(4)
L4N6-Co1-L6N1	171.8(5)	L1O1-Co3-L5O1	94.8(4)
L4N6-Co1-L6N6	90.9(5)	L1O1-Co3-L6O1	87.3(4)
L5N1-Co1-L5N6	81.3(5)	L2O1-Co3-L3O1	91.0(4)
L5N1-Co1-L6N1	95.9(5)	L2O1-Co3-L4O1	92.3(4)
L5N1-Co1-L6N6	170.5(4)	L2O1-Co3-L5O1	86.3(4)
L5N6-Co1-L6N1	92.8(5)	L2O1-Co3-L6O1	174.6(4)
L5N6-Co1-L6N6	89.7(5)	L3O1-Co3-L4O1	86.8(4)
L6N1-Co1-L6N6	81.3(5)	L3O1-Co3-L5O1	175.0(4)
L1N1-Co2-L1N6	81.3(5)	L3O1-Co3-L6O1	93.3(4)
L1N1-Co2-L2N1	97.4(5)	L4O1-Co3-L5O1	89.2(4)
L1N1-Co2-L2N6	171.1(5)	L4O1-Co3-L6O1	91.1(4)
L1N1-Co2-L3N1	97.4(5)	L5O1-Co3-L6O1	89.6(4)
L1N1-Co2-L3N6	91.2(5)	Co3-L1O1-L1N6	108.3(8)
L1N6-Co2-L2N1	92.6(5)	Co3-L2O1-L2N6	109.0(8)
L1N6-Co2-L2N6	90.0(5)	Co3-L3O1-L3N6	108.6(7)
L1N6-Co2-L3N1	171.1(5)	Co3-L4O1-L4N6	107.9(8)
L1N6-Co2-L3N6	90.2(5)	Co3-L5O1-L5N6	109.5(7)
L2N1-Co2-L2N6	81.4(5)	Co3-L6O1-L6N6	109.1(7)
L2N1-Co2-L3N1	96.4(5)	Co1-L4N6-L4O1	122.2(9)
Co1-L5N6-L5O1	122.1(8)	L4N6-L4C4-L4C5	122(1)
Co1-L6N6-L6O1	122.0(9)	L5N6-L5C4-L5C5	121(1)
Co2-L1N6-L1O1	121.9(9)	L6N6-L6C4-L6C5	122(1)
Co2-L2N6-L2O1	122.2(8)	L1C2-L1C4-L1C5	127(2)
Co2-L3N6-L3O1	121(1)	L2C2-L2C4-L2C5	124(1)
Co1-L4N6-L4C4	117(1)	L3C2-L3C4-L3C5	124(1)
Co1-L5N6-L5C4	117.2(9)	L4C2-L4C4-L4C5	125(1)
Co1-L6N6-L6C4	118(1)	L5C2-L5C4-L5C5	127(1)
Co2-L1N6-L1C4	118(1)	L6C2-L6C4-L6C5	128(2)
Co2-L2N6-L2C4	117(1)	L1C3-L1C2-L1C4	119(1)
Co2-L3N6-L3C4	116.6(9)	L2C3-L2C2-L2C4	121(1)
L1O1-L1N6-L1C4	120(1)	L3C3-L3C2-L3C4	118(1)
L2O1-L2N6-L2C4	120(1)	L4C3-L4C2-L4C4	121(1)
L3O1-L3N6-L3C4	123(1)	L5C3-L5C2-L5C4	118(1)
L4O1-L4N6-L4C4	121(1)	L6C3-L6C2-L6C4	117(2)
L5O1-L5N6-L5C4	121(1)	L1N1-L1C2-L1C4	117(1)
L6O1-L6N6-L6C4	120(1)	L2N1-L2C2-L2C4	116(1)
L1N6-L1C4-L1C2	111(1)	L3N1-L3C2-L3C4	116(1)

Table 6. (Continued)

Atoms	Degrees	Atoms	Degrees
L2N6-L2C4-L2C2	113(1)	L4N1-L4C2-L4C4	116(1)
L3N6-L3C4-L3C2	114(1)	L5N1-L5C2-L5C4	117(1)
L4N6-L4C4-L4C2	113(1)	L6N1-L6C2-L6C4	118(2)
L5N6-L5C4-L5C2	112(1)	L1N1-L1C2-L1C3	124(2)
L6N6-L6C4-L6C2	111(1)	L2N1-L2C2-L2C3	123(1)
L1N6-L1C4-L1C5	122(2)	L3N1-L3C2-L3C3	126(1)
L2N6-L2C4-L2C5	123(1)	L4N1-L4C2-L4C3	123(1)
L3N6-L3C4-L3C5	122(1)	L5N1-L5C2-L5C3	125(1)
L6N1-L6C2-L6C3	124(1)		
Co1-L4N1-L4C2	112.2(9)		
Co1-L5N1-L5C2	112(1)		
Co1-L6N1-L6C2	112(1)		
Co2-L1N1-L1C2	113(1)		
Co2-L2N1-L2C2	112.4(9)		
Co2-L3N1-L3C2	113.3(9)		

distances indicates that the central cobalt can be assigned as cobalt(II).

Thus, two of the three cobalts are oxidized in the absence of air, and presumably some of the ligand is reduced. The same results are obtained in air. Apparently, the field provided by six nitrogens is sufficient to allow the oxidation and reduction to occur, while that provided by six oxygens is not. Only part of the cobalt is oxidized, because there is not enough ligand present to coordinate all the metal.

It is interesting to compare and contrast this structure and that of the previously discussed complex of 2-aminoethanol (see Figure 2). Both consist of two terminal cobalt(III) ions and a central cobalt(II) arranged linearly. Although coordination of the terminal cobalt ions is octahedral in both complexes, coordination at the central cobalt ion differs. Coordination of the central cobalt(II) in the 2-aminoethanol complex is trigonal prismatic and there is twofold site symmetry (The two tris chelates are of the same optical configuration). This contrasts with the octahedral coordination of the central cobalt(II) in the Dma complex and the absence of symmetry (The approach to a threefold symmetry can be seen in Figure 7).

Another interesting feature is that the 2-aminoethanol complex is formed by oxidation of cobalt(II) in air, while the Dma complex is formed in air or in the absence of

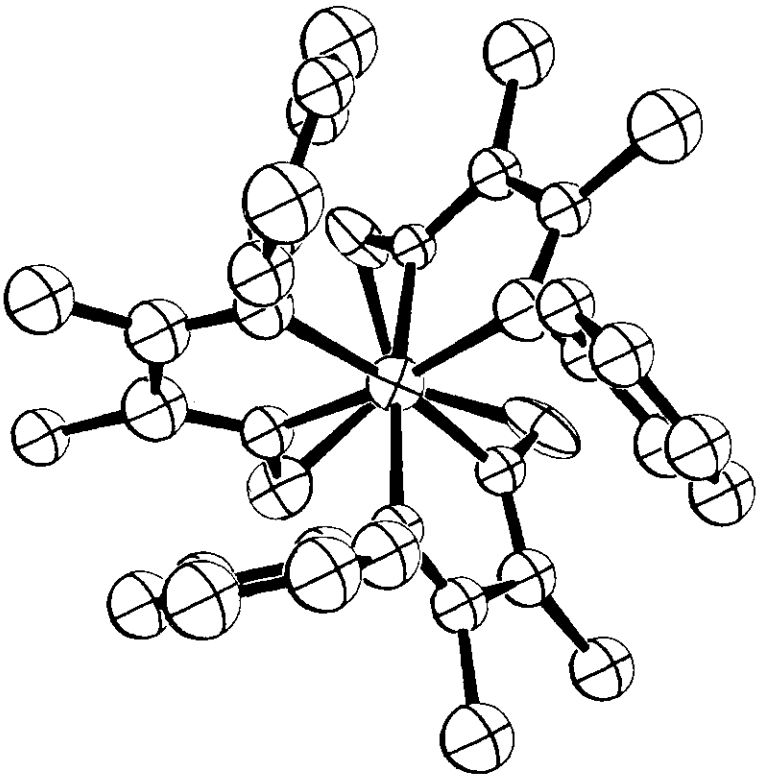

Figure 7. A View of $[Co_3(Dma)_6](ClO_4)_2$ Along the Co(III) - Co(II) Axis (One Co (III) and Associated Ligands Omitted)

air. The difference lies presumedly in the nature of the ligands. As discussed earlier, the field provided by six nitrogens in the Dma complex is apparently sufficient to permit oxidation in the absence of air. However, in the 2-aminoethanol complex, each of the oxidized cobalts is surrounded by three nitrogens and three oxygens. Also, the 2-aminoethanol is less easily reduced than the Dma and this diminishes its ability to serve as an oxidizing agent.

Comparison of the refined structure with measured density, analyses, and residual electron density that could not be refined indicates that something else is present in the crystalline compound. Difficulties involving inconsistent weight loss and cracking of the crystals make a definite interpretation impossible. However, a reasonable explanation would be the presence of disordered solvent and/or water molecules in the crystal. If sufficiently disordered, such molecules would not show up in a difference Fourier calculation.

It should be pointed out that there is not a marked difference between the %C, H, and N for the formula proposed by Uhlig and Dinjus and the values for the actual structure. Their formulation is not unreasonable in the absence of a structure determination.

The magnetic moment per gram atom of cobalt can be recalculated in terms of the new formulation, assuming the cobalt(III) ions are diamagnetic. Although Uhlig and Dinjus

report two different compounds, $[Co(Dma)(Cma-H)B]ClO_4$ where B = C_5H_5N or $C_6H_5NH_2$, the same compound, $[Co_3(Dma)_6](ClO_4)_2$, was obtained using either procedure; crystals from both preparations gave the same unit cell parameters. The recalculated room temperature magnetic moment reported for the aniline complex, 5.17 B.M., is in the normal range for octahedral cobalt(II). However, the value for the pyridine complex, 5.95 B.M., is not in the normal range and can not be explained. No temperature dependence is exhibited since only a single paramagnetic center is present in each formula unit.

CHAPTER IV

CONCLUSION

In reviewing the mixed-valence polynuclear cobalt complexes that have been reported, it can be seen that they fall into two categories; those that exhibit temperature-dependent magnetic moments and those that exhibit temperature independent magnetic properties. In all cases a direct assignment of charge at the cobalt ions has been possible on the basis of bond distances and no delocalization of charge has been evident. $[Co_3(Dma)_6](ClO_4)_2$ is consistent with the above and represents another example of a polynuclear cobalt complex with a single paramagnetic center.

Other polynuclear cobalt complexes could probably be prepared using similar ligands and oxidation of the central cobalt would be interesting. Also, replacement of the central cobalt by other metal ions could be attempted.

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